This User Manual is the PLC of GSK988TA/988TA1/988TB Series Turning Machine CNC System

This user manual describes all proceedings concerning the operations of this CNC system which is GSK988TA/988TA1/988TB in detail as much as possible. However, it is impractical to give particular descriptions for all unnecessary or unallowable system operations due to the manual text limit, product specific applications and other causes. And therefore, the proceedings not indicated herein should be considered impractical or unallowable.

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PREFACE

Your Excellency：

It's our pleasure for your patronage and purchase of this GSK GSK988TA/988TA1/988TB CNC system made by GSK CNC Equipment Co., Ltd.

This Manual is the "PLC" of the GSK988TA/988TA1/988TB Series Turning Machine CNC System, which introduces the detailed PLC user manual, signal manual, programming compilation, as well the introduction of the GSKLadder software.

In order to guarantee the product is operated with a safe, normal and effective situation, it is necessary to carefully read this manual before installing and using this product.

SECURITY PRECAUTION

Accident may occur by improper connection and operation!

This system can only be operated by authorized and qualified personnel. Please carefully read this manual before using!

Especially: The system power installed on/inside the chassis is the dedicated power supplied by GSK CNC SYSTEM.

Never attempt to use this power for other purposes; otherwise, the great hazard may occur!

STATEMENT

- **We will try to describe all the various matters as much as possible in this manual. However, it is impossible to give detailed descriptions to all the unnecessary or unallowable operations because there are too many possibilities. Therefore, the matters not specially described herein should be considered as "impossible" or "unallowable".**

WARNING

- **It is necessary to carefully read this User Manual and the one from the machine tool manufacture before programming and operating this product, strictly operate the product based upon the Manual; otherwise, the product and machine tool may be damaged, the workpiece may wasted, as well the personal injury.**

NOTICE

- **The functions and specifications (such as the precision and speed, etc.) described in this manual are only for this product itself. For those CNC machine tools installing this product, the actual function configuration and specifications depend on the designs of the machine tool builders. Moreover, the function configuration and specifications of the CNC machine tool are subject to the manual provided by the machine tool builder.**

All specifications and designs in this manual are subject to change without notice.

PRECAUTION

■ Transportation and Storage

- **Do not pile up the carton over 6 layers.**
- **Do not climb, stand on the carton; do not place heavy objects on it.**
- **Do not drag or move the products using the cables connected with the product.**
- **Do not impact, scratch the panel and screen.**
- **Avoid from the damp, the sunshine and the rain on the product carton.**

■ Unpacking inspection

- **Check whether it is your purchased product after unpacking the carton.**
- **Check whether the product is damaged during transporting.**
- **Check whether the components are prepared or damaged comparing with the packing list.**
- **It is necessary to contact our company immediately if the product type is inconsistent with the packing list, lack of accessories or damage in transportation.**

■ Wiring

- **Only the person who executes the wiring and inspection should have the corresponding professional capacity.**
- **The product should be reliably grounded, and its resistance should be less than 0.1Ω and can not be used the neutral conductor (zero cable) to replace the ground wire.**
- **The wiring should be correct and firm, otherwise, possibly causing the malfunction in product or unexpected result.**
- **The surge absorb diode connected with the product should be linked based upon the described direction, otherwise, it may damage the product.**
- **The product power should be turned off before plugging or unplugging the product cabinet.**

■ **Overhaul**

- **Cut off the power before inspecting and maintaining or changing the components.**
- **Check the malfunction when the short-circuit or overloading occurs. The computer can be started after the malfunction is eliminated.**
- **Do not power ON/OFF frequently for the product, if you want to turn on the power again after power off, its interval time is 1min. at least.**

SECURITY RESPONSIBILITY

Security responsibility of the manufacturer

——Manufacturer should take responsibility for the design and structure danger of the motor and the accessories which have been eliminated and/or controlled.

——Manufacturer should take responsibility for the security of the motor and accessories.

——Manufacturer should take responsibility for the offered information and suggestions for the user.

Security responsibility of the users

——User should know and understand about the contents of security operations by learning and training the security operations of the CNC system.

——User should take responsibility for the danger because of increasing, changing or modifying the original CNC system or accessories by themselves.

——User should take responsibility for the danger without following the operations, maintenances, installations and storages described in the manual.

This manual is stored by the last user.

Sincerely thanks for your friendly supporting of GSK's products!

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CHAPTER 1 PLC USER MANUAL

1.1 PLC Specification

PLC System Version	NP1
Programming Language	Ladder Diagram
Programming Software	GSKLadder
Programming Progression	2
Execution Period of the First-Level	8ms
Average Processing Time for Basic Instructions	<2μs
Maximum Steps	5000 steps
Programming Instructions	Basic instructions + function instructions

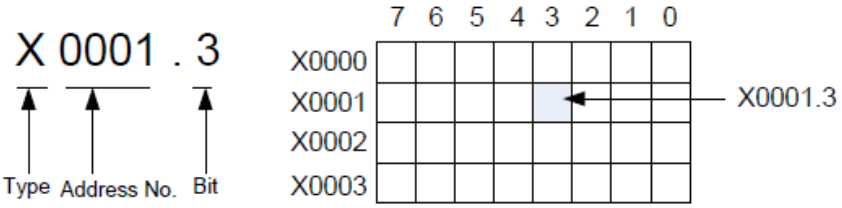
PLC Addresses	Ranges	Data Size	Remark
Internal relay address (R)	R0000 ~ R0999	1 Byte	read/write
Information display request address (A)	A0000 ~ A0024	1 Byte	read/write
Timer address (T)	T0000 ~ T0099	4 Bytes	read only
Counter address (C)	C0000 ~ C0099	4 Bytes	read only
Data table address (D)	D0000 ~ D0999	4 Bytes	read/write
Holding relay address (K)	K0000 ~ K0039	1 Byte	read/write
Counter preset address (DC)	DC0000 ~ DC0099	4 Bytes	read/write
Timer preset address (DT)	DT0000 ~ DT0099	4 Bytes	read/write
Subprogram address (P)	P0000 ~ P9999	/	Inaccessible
Label address (L)	L0000 ~ L9999	/	Inaccessible
Machine→ PLC address (X)	X0000 ~ X0127	1 Byte	read only
PLC→machine address (Y)	Y0000 ~ Y0127	1 Byte	read/write
CNC→PLC address (F)	F0000 ~ F0255	1 Byte	read only
PLC→CNC address (G)	G0000 ~ G0255	1 Byte	read/write

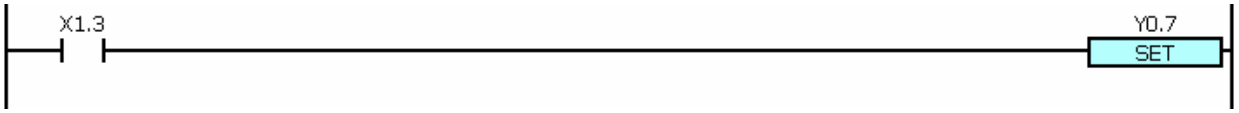
1.2 PLC Addresses

The PLC reads the data from the addresses in bit unit or in byte unit (including single-byte type, double-byte type and four-byte type), which are expounded below:

When reading in bits, the state of a certain bit is read out in the PLC addresses, such as the input/output status of external I/O point or the bit status in the process. The bit address of PLC consists of address type, address number and bit number.

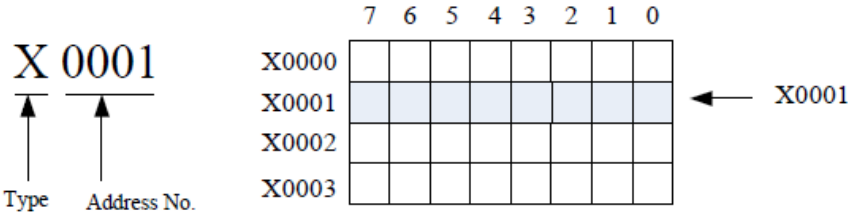
Example: X0001.3 represents the status of bit 3 of PLC external input address X0001.





When reading in bytes, the data stored in the single or continuous addresses in the PLC are read out, such as the value of PLC data parameter D. The byte address of PLC consists of address type and address number.

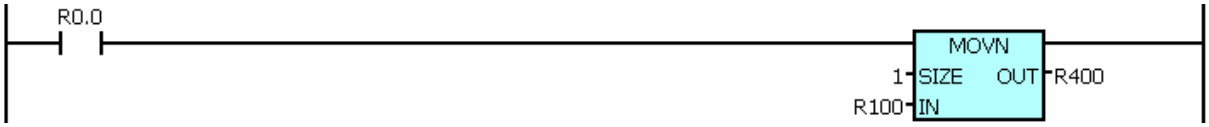
Example: X0001 represents the address of PLC external input address X0001 (data size: 8 bits).



There are three methods when PLC addresses are read in bytes, the following examples are shown the above-mentioned explanation:

- Single-byte type

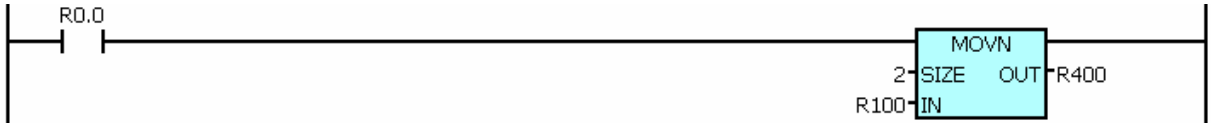
Example:



or

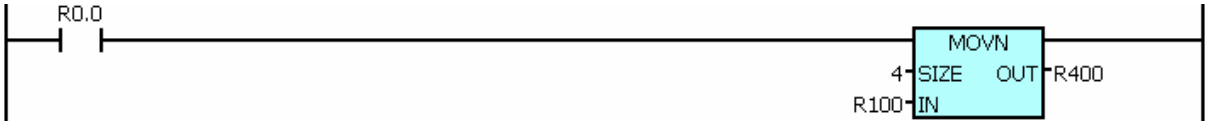
- Double-byte type

Example:

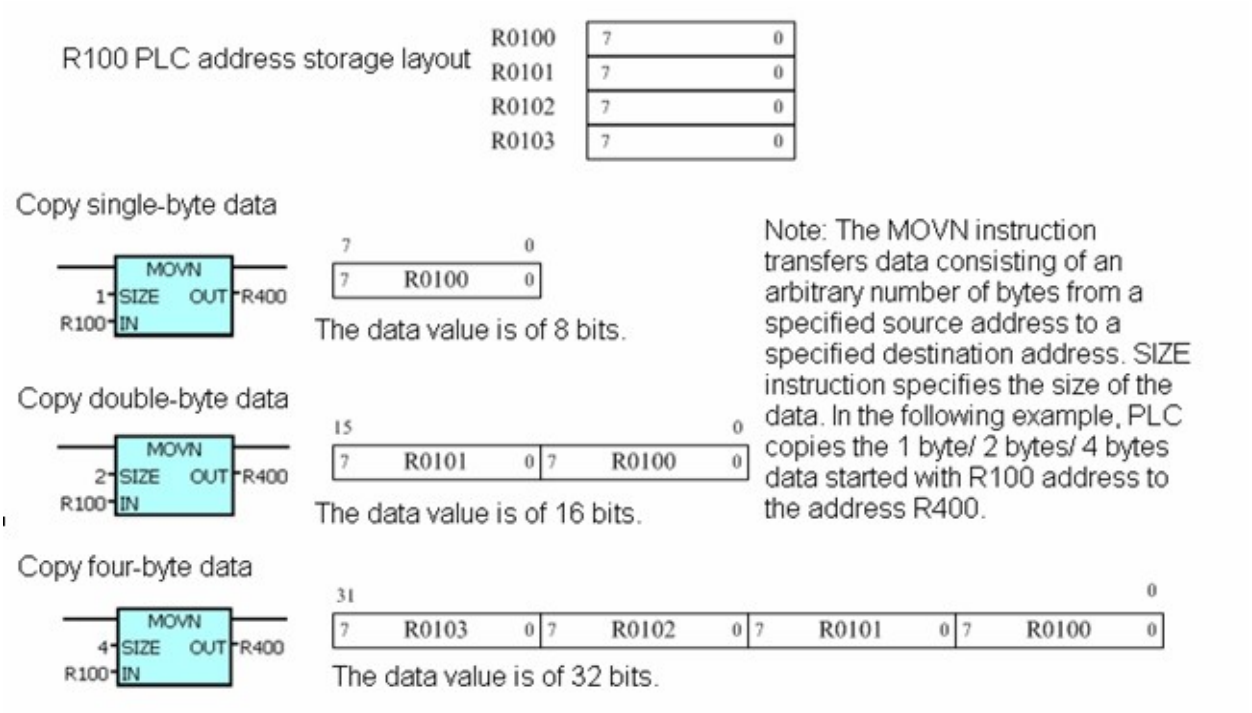


- Four-byte type

Example:



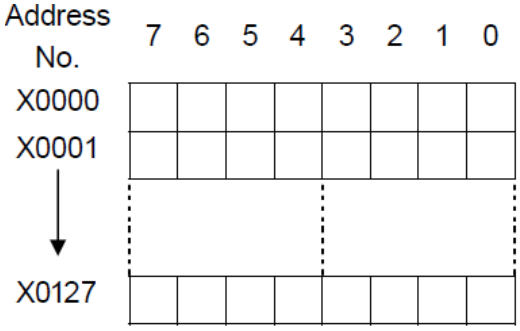
The data that obtained by the three methods are shown as follows:


R100 PLC address storage layout
R0100
R0101
R0102
R0103
Copy single-byte data
MOVN
1 SIZE OUT R400
R100 IN
R0100
The data value is of 8 bits.
Copy double-byte data
MOVN
2 SIZE OUT R400
R100 IN
R0101 R0100
The data value is of 16 bits.
Copy four-byte data
MOVN
4 SIZE OUT R400
R100 IN
R0103 R0102 R0101 R0100
The data value is of 32 bits.
Note: The MOVN instruction transfers data consisting of an arbitrary number of bytes from a specified source address to a specified destination address. SIZE instruction specifies the size of the data. In the following example, PLC copies the 1 byte/ 2 bytes/ 4 bytes data started with R100 address to the address R400.

Note: For the four-byte type address (DT, DC, D, T, C), if the data size is 4 bits, usually, the specified SIZE in the PLC instructions is 4, then the data read out is 32 bits (binary system). If the specified SIZE is 1 or 2, the data after truncation is read out; if the specified SIZE is 1 byte, the LOW (8-bit) is read out; if the specified SIZE is 2 bytes, the LOW (16-bit) is read out.

1.2.1 X Addresses (Machine→PLC)

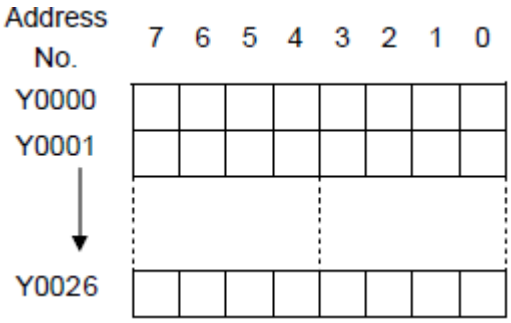
GSK988TA/988TA1/988TB PLC X addresses are divided into three types, the first type (X0000.0～X0004.7) are mainly assigned to the CNC I/O interfaces, including the fixed addresses (such as external ESP interface X0.5) and definable address. They are used for the input of machine external signal; the second type (X0010.0～X0026.7) are mainly assigned to input keys on the operation panel. The 3rd addresses (X0030.0～X0127.7) are distributed to the common I/O port. X address can be read only, it is single-byte address and the data size is 8 bits.



Note: In the PLC X addresses, only the X address that is defined by CNC can be read, otherwise, the address is meaningless.

1.2.2 Y Addresses (PLC→Machine)

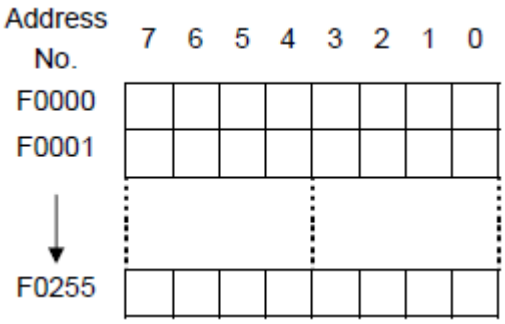
Y addresses are divided into two types, the first type (Y0030.0 ~ Y0127.7) are mainly assigned to the CNC I/O interfaces. They are all definable addresses. The other one (Y0010.0 ~ Y00026.7) are assigned to the machine panel. Y address is the single-byte type; its data size is 8 bits.



Note: In the PLC Y addresses, only the Y address that is defined by CNC can be read, otherwise, the address is meaningless.

1.2.3 F Addresses (CNC→PLC)

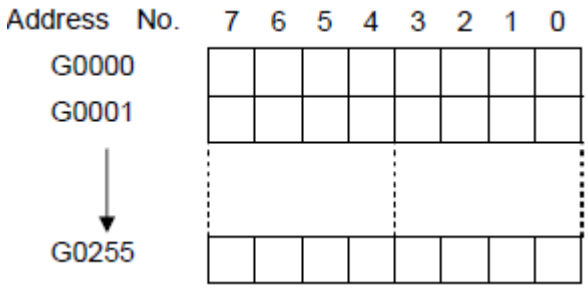
F address can be read only.Address range: F0000 ~ F0255; Single-byte type; Data size: 8 bits



Please refer to the APPENDIX for the detailed functions of F addresses.

1.2.4 G Addresses (PLC→CNC)

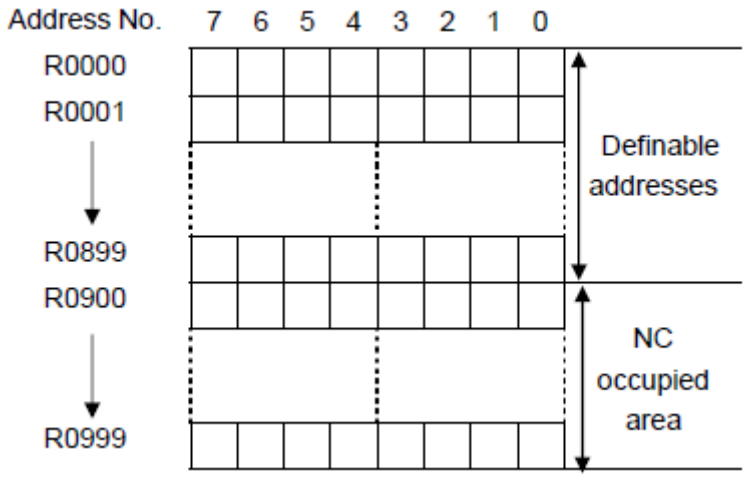
Address range: G0000 ~ G0255; Single-byte type; Data size: 8 bits



Please refer to the APPENDIX for the detailed functions of G addresses.

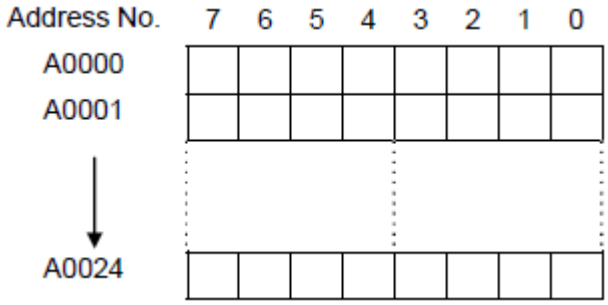
1.2.5 Internal Relay Addresses (R)

Address range: R0000～R0999; Single-byte type; Data size: 8 bits.This address area is cleared to zero after power-on.



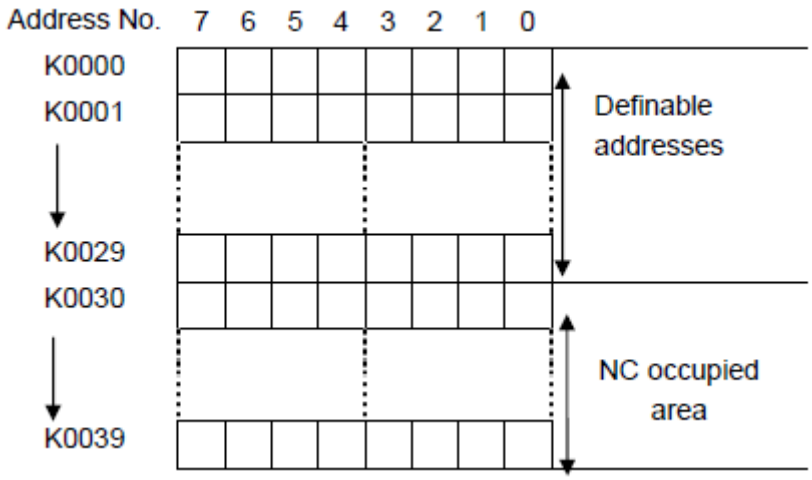
1.2.6 Information Display Request Addresses (A)

Address range: A0000～A0024; Single-byte type; Data size: 8 bits.This address area is cleared to zero after power-on. It is used for PLC alarms.



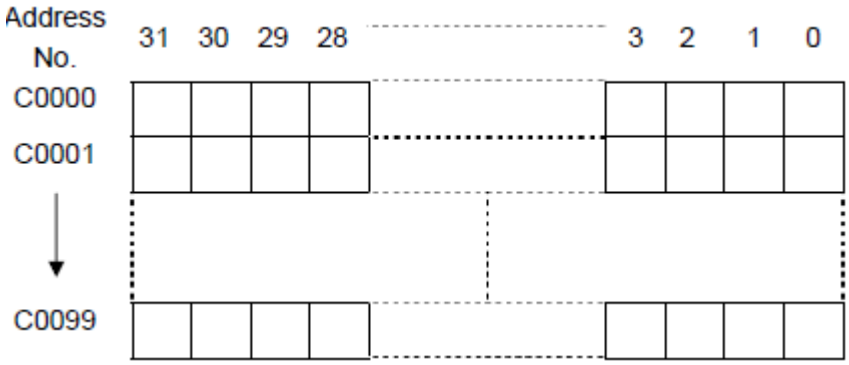
1.2.7 Holding Relay Addresses (K)

This address area is used for holding relay and PLC parameter setting. The data can be saved when power-off.Address range: K0000～K0039; Single-byte type; Data size: 8 bits



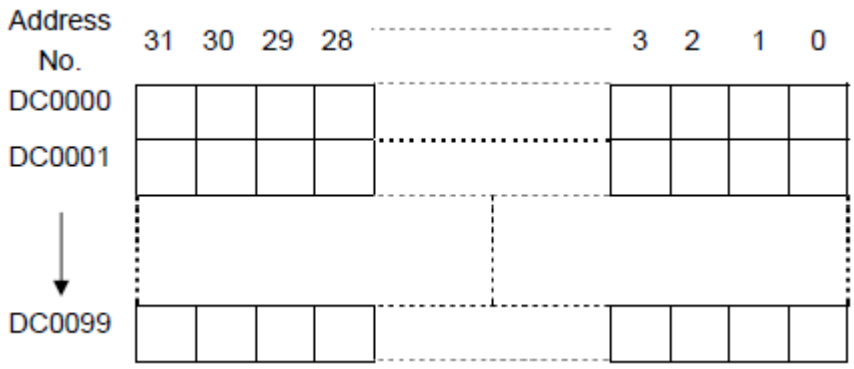
1.2.8 Counter Addresses (C)

This address area is used for storing the current counting value in the counter. The data are saved after power-off.Address range: C0000 ~ C0099; Value range: 0 ~ 21,4748,3647



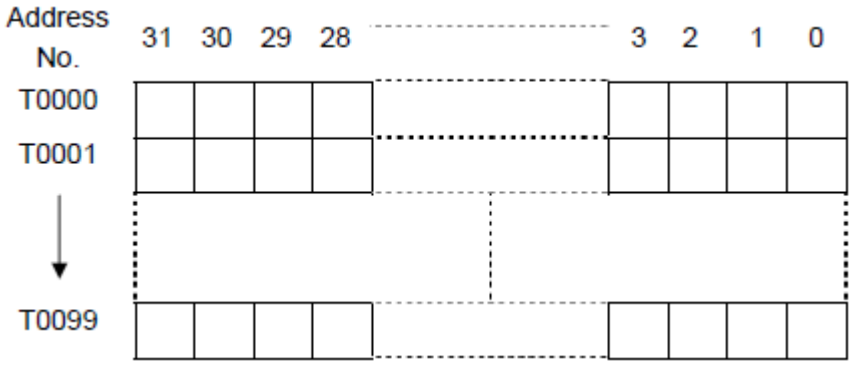
1.2.9 Counter Preset Addresses (DC)

This address area is used to store the counter preset value. The data are saved after power-off. Address range: DC0000 ~ DC0099; Data size:32 bits; Value range: 0 ~ 21,4748,3647.



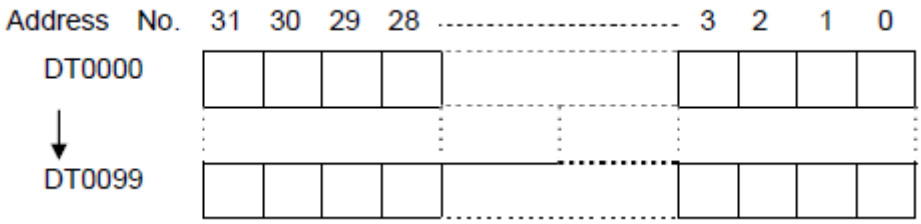
1.2.10 Timer Addresses (T)

This address area is used to store the current value of the timer. The data are saved after power-off.Address range: T0000 ~ T0099; Data size: 32 bits; Value range: 0 ~ 21,4748,3647



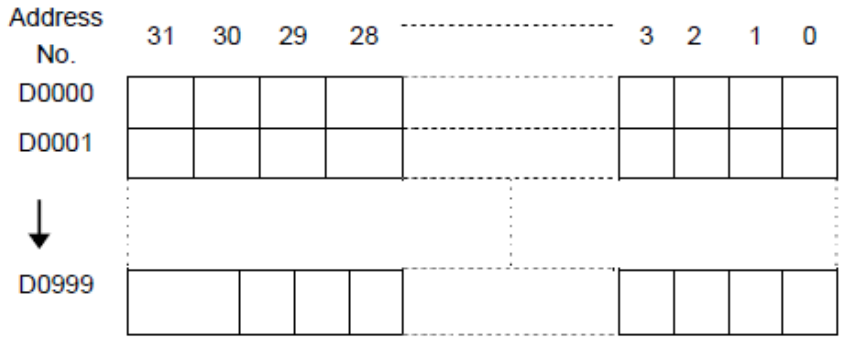
1.2.11 Timer Preset Addresses (DT)

This address area is used to store the timer preset values. The data are saved after power-off. Address range: DT0000~DT0099; Data size: 32 bits; Value range: 0 ~ 21,4748,3647



1.2.12 Data Table Addresses (D)

The data of the data table address are saved after power-off.Address range: D0000 ~ D0999; Data size: 32 bits; Value range: 0 ~ 21,4748,3647



1.2.13 Label Addresses (L)

It is used to specify the label of jump destination in JMPB instruction and the label of LBL instruction.

Direct access to the L address in PLC is forbidden. L address can only be used in PLC function instructions JMPL and LBL.Address range: L0 ~ L9999

1.2.14 Subprogram Numbers (P)

Subprogram numbers are used to specify destination subprogram numbers in the CALL and SP instructions.

Direct access to the P address in PLC is forbidden. L address can only be used in PLC function instructions SP and CALL.Address range: P0 ~ P9999

1.3 PLC Basic Instructions

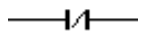
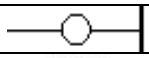
Basic instructions are most often used when designing sequence programs. They perform one-bit operation. The basic instructions in this CNC are shown as follows:

Instructions	Functions	Components
LD	Read the normal-open contact status	X, Y, F, G, R, K, A
LDI	Read the normally-closed contact status	X, Y, F, G, R, K, A
OUT	Output coil	Y, G, R, K, A
OUTN	Coil output when the condition is not fulfilled	Y, G, R, K, A
AND	Normally-open contacts in series	X, Y, F, G, R, K, A
ANI	Normally-closed contacts in series	X, Y, F, G, R, K, A
OR	Normally-open contacts in parallel	X, Y, F, G, R, K, A
ORI	Normally-open contacts in parallel	X, Y, F, G, R, K, A
ORB	Series circuits in parallel	None
ANB	Parallel circuit in series	None
MPS	Push logic result to stack	None
MRD	Read the top-of-stack result	None
MPP	Pop the top-of-stack result	None

1.3.1 LD, LDI, OUT, OUTN

●Mnemonics and functions

Mnemonics	Functions	Symbols
LD	Read normally-open contact status	

LDI	Read normally-closed contact status	
OUT	Output coil	
OUTN	Output NOT	

●Instruction explanation:

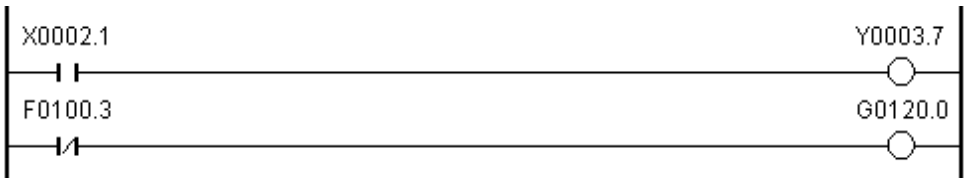
A: LD, LDI instructions are used to connect the contact to the bus. Other functions can be used on the branch start point along with the following ANB instruction.

B: OUT instruction is used to drive the output relay, internal relay coil. It cannot be used in input relay.

C: Parallel OUT instruction can be used repeatedly.

D: OUTN instruction inversely outputs the drive condition. Other usages are the same as OUT.

●Programming example:

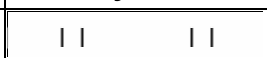


Explanation: Read the status of X0002.1, if it is 1, Y0003.7 is output.

Read the status of F0100.3, if it is 0, G0120.0 is output.

1.3.2 AND, ANI

●Mnemonics and functions

Mnemonics	Functions	Symbols
AND	Normally-open contacts in series	
ANI	Normally-closed contacts in series	

●Instruction explanation:

AND and ANI instructions can connect one contact in series. The serial contact number is not limited. This instruction can be used repeatedly.

●Programming example

Explanation: Read the status of X0002.1.

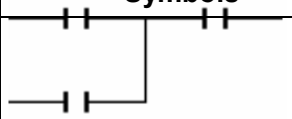
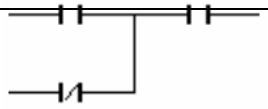
Read the status of F0100.3 and connect it with the status of X0002.1 in parallel.

Read the status of X0008.6 and connect the previous two in parallel.

When the X0002.1 and X0008.6 are 1, and F0100.3 is 0, Y0003.7 is output.

1.3.3 OR, ORI

●Mnemonics and functions

Mnemonics	Functions	Symbols
OR	Normally-open contacts in parallel	
ORI	Normally-closed contacts in parallel	

●Instruction explanation:

A: OR, ORI instructions are used to connect one contact in parallel. If more than two contacts are connected in series, and then this kind of circuit is connected with other circuits in parallel, ORB instruction aftermentioned is used.

B: OR or ORI means the parallel connection between the instruction step and the LD, LDI instruction steps.

●Programming example

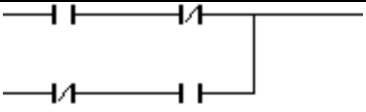
Explanation: Read the status of X0002.1

Read the status of F0100.3 and connect it with X0002.1 in parallel.

When X0002.1 is 1 or F0100.3 is 0, Y0003.7 is output.

1.3.4 ORB

●Mnemonics and functions

Mnemonics	Functions	Symbols
ORB	Serial circuits in parallel	

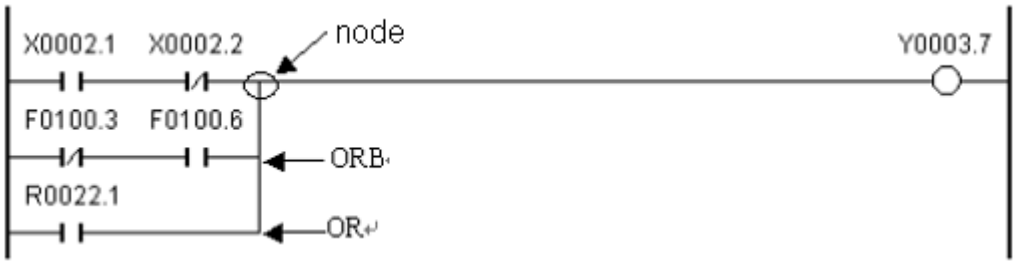
●Instruction explanation:

A: The circuit which is more than two contacts is connected in series is called serial circuit. When serial circuits are connected in parallel, the LD, LDI instructions are used for branch start, the

ORB instruction is used for branch end.

B: ORB instruction is an independent instruction without address.

●Programming example

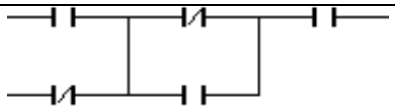


Explanation: There are three branches (0002, 0003, and 0004) from the left bus to the node. Branches 0002 and 0003 are serial circuits. When there are serial circuits connected in parallel between the bus to the node or node to node, ORB instruction is used for the all the branch ends except for the first branch. As branch 0004 is not serial circuit, OR instruction can be used.

ORB and ANB are instructions without components, they indicate the OR, AND relations of circuits.

1.3.5 ANB

●Mnemonics and functions

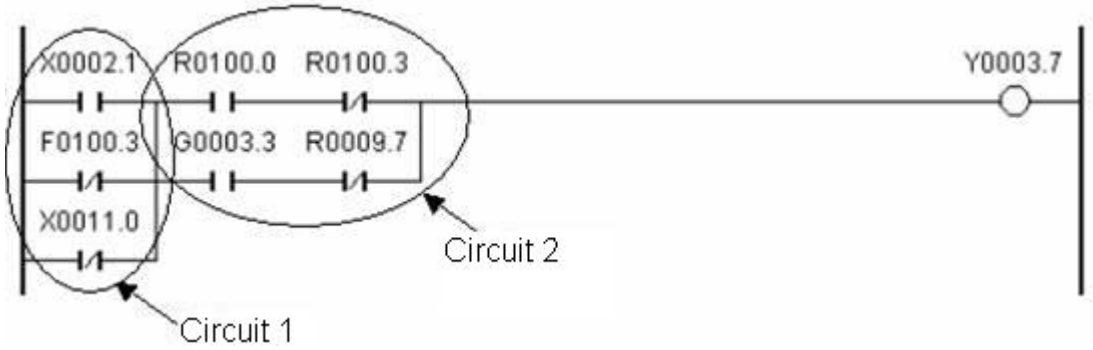
Mnemonics	Functions	Symbols
ANB	Parallel circuits in series	

●Instruction explanation:

A: When the branch circuit (parallel circuit) is connected with the previous circuits in series, ANB instruction is used. LD, LDI instructions are used for branch start; ANB instruction is used when the serial circuit is ended and is connected in series with the previous circuits.

B: ANB instruction is an independent instruction without address.

●Programming example



Explanation: ORB indicates the serial circuits in parallel in circuit 2; ANB indicates the circuit 1 and circuit 2 are connected in series.

1.3.6 MPS, MRD, MPP

The PLC system (NP1) in GSK988TA/988TA1/988TB supports the multiple levels output.

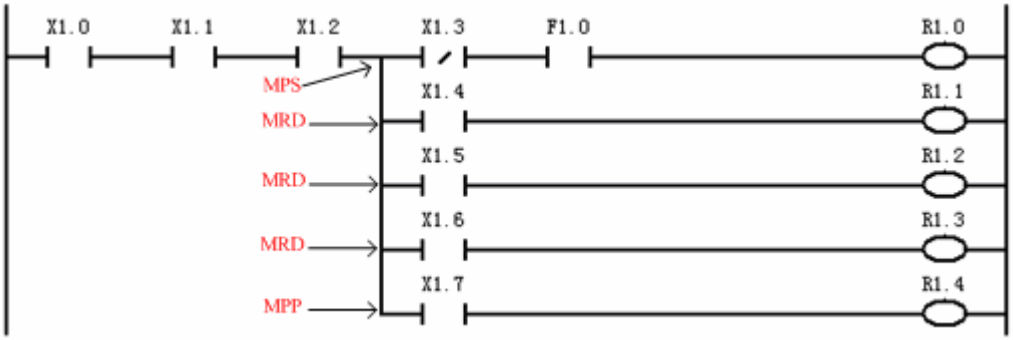
(1). MPS (Memory Push): This instruction stores the calculation at the top of the stack and moves other values to the bottom of the stack.

(2). MRD (Memory Read): This instruction reads the top of the stack.

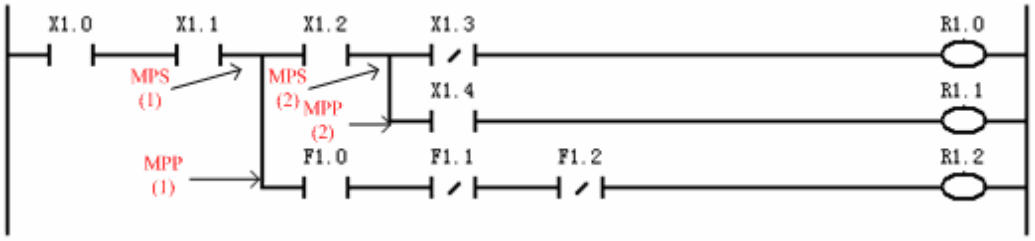
(3). MPP (Memory Pop): This instruction reads, draws down the top of the stack and moves other values towards the top of the stack.

The values in the stack can be used as many times as necessary. MPP is used at the last time.

The following figure is the stack level 1.



The following figure is the stack level 2:



Stack instruction usage:

1). There is no object component in stack instructions.

2). MPS and MPP should be used in pairs.

1.4 PLC Function Instructions

When some functions are difficult to program with basic instructions, function instructions are available to facilitate programming. PLC has following functions:

No.	Instruction	Function
1	SET	Output the logical calculation and address value after logical OR
2	RST	Output the logical calculation inversed result and address value after logical AND
3	CMP	Compare position
4	CTRC	Counter
5	TMRB	Timer
6	MOVN	Data copy

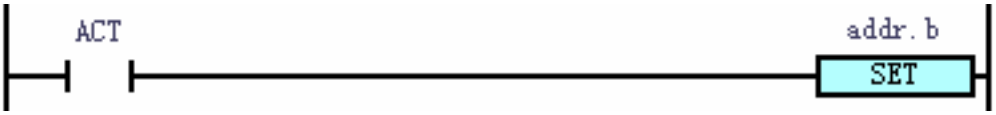
7	PARI	Parity check
8	ALT	Alternative output
9	ROTB	Binary rotation control
10	DECB	Binary decoding
11	CODB	Binary code conversion
12	JMPB	Program jump
13	LBL	Program jump label
14	CALL	Subprogram call
15	DIFU	Rising edge detection
16	DIFD	Falling edge detection
17	MOVE	Logical multiplication
18	ADDB	Binary addition
19	SUBB	Binary subtraction
20	MULB	Binary multiplication
21	DIVB	Binary division
22	WSHL	Binary data shift left
23	WSHR	Binary data shift right
24	WAND	Binary byte AND
25	WOR	Binary data OR
26	WXOR	Binary data XOR
27	WINV	Binary data inversed
28	WINDR	Read the CNC window function
29	AXCTL	PLC controllable axis

1.4.1 SET

● Function

Set the assigned address to 1.

● Format



● Control conditions

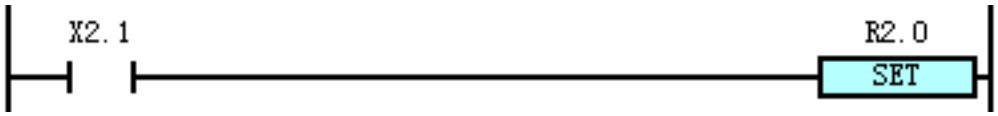
ACT = 0: The addr.b status remains unchanged.

= 1: addr.b is set to 1.

● Parameters

addr.b: address bit. It can be contact or output coil. addr= Y, G, R, K, A.

●Example:



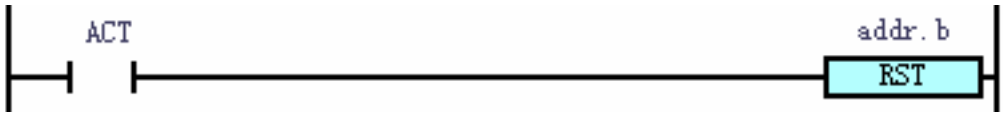
Explanation: When X0002.1 is 1, R0002.0 is set to 1; when X0002.1 is 0, the state of R0002.0 remains unchanged.

1.4.2 RST (Reset)

●Function

Set the assigned address to 0.

●Format



●Control conditions

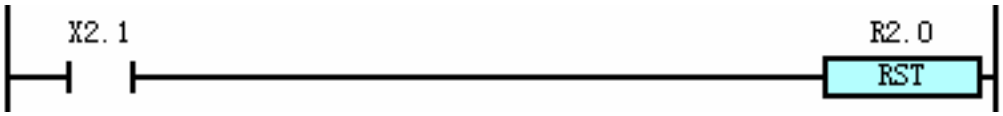
ACT = 0: The state of addr.b remains unchanged.

= 1: Addr.b is set to 0.

●Parameters

addr.b: reset the address bit. It can be contact or output coil. Addr=Y, G, R, K,A.

●Example:



Explanation: When X0002.1 is 0, the state of R0020.0 remains unchanged; when X0002.1 is 1, R0020.0 is set to 0.

1.4.3 CMP (Binary Data Comparison)

●Function

Compares two data values and outputs the result.

●Format

●Control conditions

Assume that the address of OUT is represented by addr.b, then

ACT = 0: addr.b remains unchanged

= 1: Compares IN1 and IN2, and outputs the following results:

	addr.(b+2)	addr.(b+1)	addr.(b+0)
IN1> IN2	0	0	1
IN1= IN2	0	1	0
IN1< IN2	1	0	0

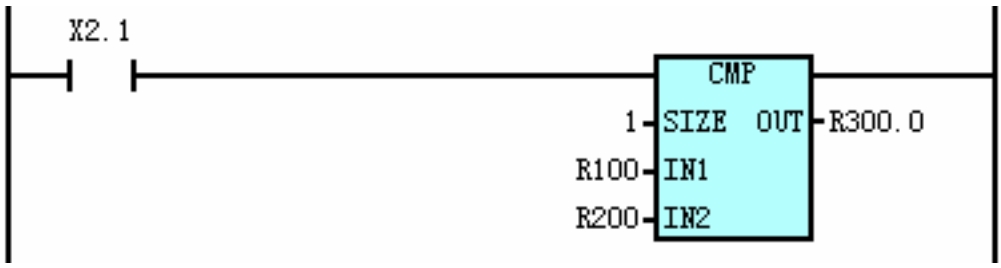
●Parameters

Size: Specifies the size of the data. When the setting value is 1, 2 or 4, the corresponding data size is 1 byte, 2 bytes or 4 bytes.

IN1, IN2: Compares the contents of source data 1 and 2. It can be constant or address number (but cannot be address bit, such as addr.b). The address number are R, X, Y, F, G, K, A, D, T, C, DC and DT etc.

OUT: Compares the output result. It can be R, Y, G, K and A etc.

●Example:



Explanation: When X0002.1 is 0, the comparison is not performed; the states of R0300.0, R0300.1 and R0300.2 remain unchanged.

When X0002.1 is 1, the comparison result is shown as follows:

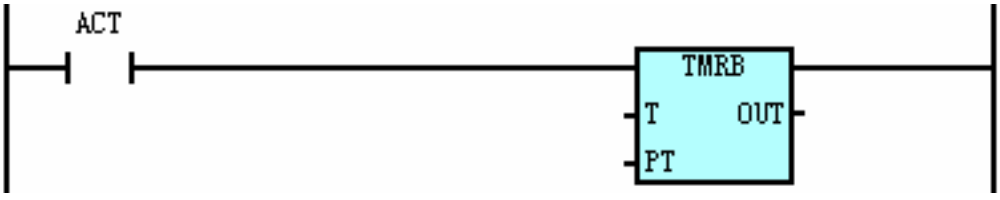
	R0300.2	R0300.1	R0300.0
R0100>R0200	0	0	1
R0100=R0200	0	1	0
R0100<R0200	1	0	0

1.4.4 TMRB (Timer)

●Function

On-delay timer; the unit is ms.

●Format

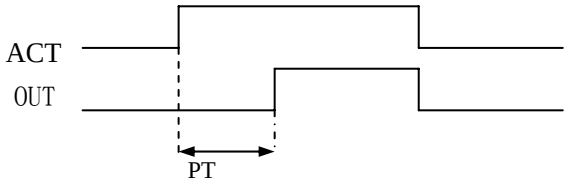


●Control conditions

ACT =0: T and OUT are reset

=1: T starts from 0, when the PT preset time (unit: ms) is reached, OUT=1.

The logical relation is shown as follows:



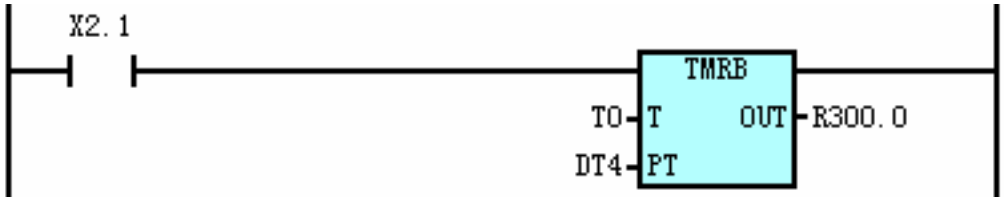
●Parameters

T: Timer number. Range: T0000 ~ T0099

PT: Timing constant or the data register started with DT. DT setting range: 0 ~ 21,4748,3647(ms)

OUT: Timer output address can be R, Y, G, K and A etc.

●Example:



Explanation:

Assume that the current setting value of DT0004 is 100.

When X0002.1 is 0, both T0000 and R0300.0 are 0.

When X0002.1 is 1, after the T0000 starts timing and reaches 100 ms (set by DT0004), R0300.0 is set to 1.

1.4.5 CTRC (Binary Counter)

●Function

The data in this counter are in binary. The following functions are available:

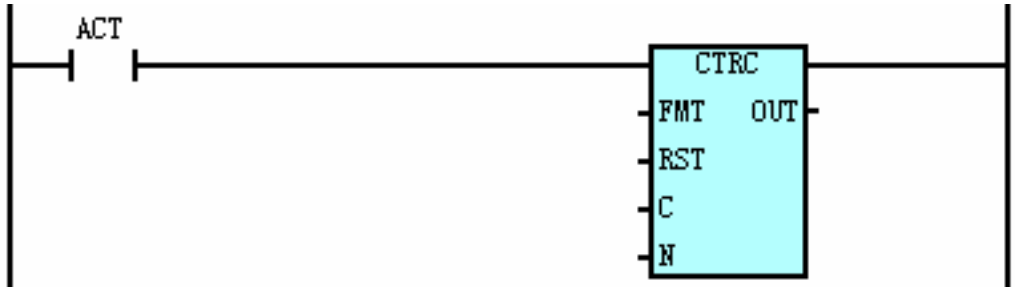
A: Preset counter: Presets the count value and outputs corresponding signal if the count reaches this preset value.

B: Ring counter: Resets to the initial value when the count signal is input after the counter reaches the preset value.

C: Up/down counter: It is the reversible counter to be used as both the up counter and down counter.

D: Selection of the initial value: Either 0 or 1 can be selected as the initial value.

●Format



●Control conditions

When ACT is rising edge (from 0 to 1):

Count up: The count up instruction counts up from the initial value. C counts up each time when rising edge appears. When the current value C reaches the preset value (N), OUT=1; when C is less than N, OUT=0. If the rising edge appears again, C counts from the initial value and meanwhile OUT=0.

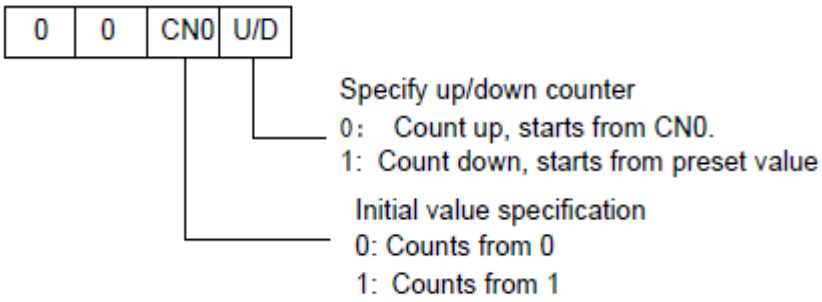
Count down: The count down instruction counts down from the preset value. C counts down each time when rising edge appears. When the current value C reaches the preset value (N), OUT=1; when C is greater than N, OUT=0. If the rising edge appears again, C counts from the initial value and meanwhile OUT=0.

When ACT=0:

C and OUT remain the same.

●Parameters

FMT: Data format



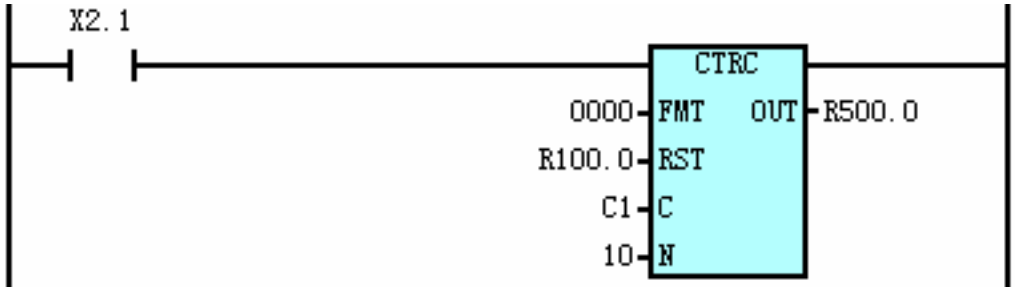
RST: When RST is 1, C=CN0 and OUT=0, (regardless of the state of ACT). RST can be X, Y, G, F, R, K or A etc.

C: Specifies the counter number which is represented with Cxxx, xxx is the number (0~99).

N: Counter preset value. It can be constant or the data register started with DC. If it is constant, the range is from 0 to 21, 4748, 3647.

OUT: Outputs position 1 when it reaches the count value. OUT can be R, Y, G, K or A etc.

●Example:



Explanation:

When R0100.0 is 1, C0001=0, R0500.0=0;

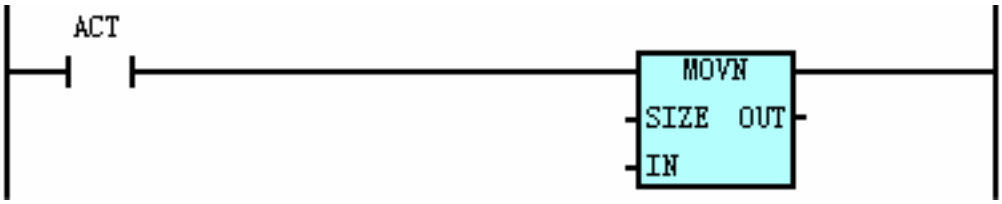
When R0100.0 is 0, each time rising edge appears at X0002.1, C0001 counts up once. When the C reaches 10, R0500.0 is set to 1. When the rising edge appears at X0002.1 again, C is reset to 0 and starts counting, R0500.0 is set to 0.

1.4.6 MOVN (Binary Data Transfer)

●Function

Transfers binary data (data copy) from a specified source address to a specified destination address.

●Format



●Control conditions

ACT = 0: OUT remains the same.

= 1: Copy values or constants from IN to OUT.

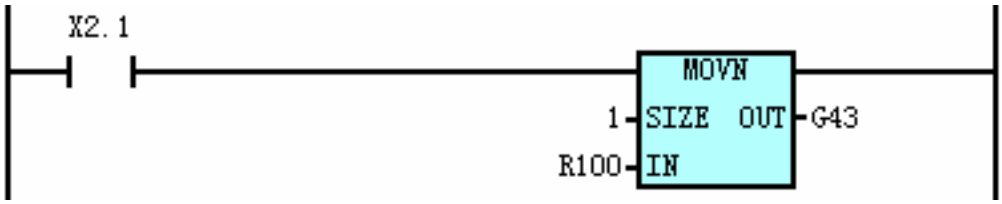
●Parameters

SIZE: Copy the size of data (1, 2, 4 bytes)

IN: The leading byte or constant of source data address. Addresses are R, X, Y, F, G, K, A, D, T, C, DC, and DT etc.

OUT: The leading byte of destination address. Addresses are R, Y, G, K, A, D, T, C, DC and DT etc.

●Example:



Explanation:

When X0002.1 is 1, it transfers R0100 value (1 byte) to G0043.

1.4.7 DECB (Binary Decoding)

●Function

DECB decodes binary code data. When one of the specified eight consecutive numbers matches the code data, the corresponding output data is 1; if these numbers do not match, the output data is 0. This instruction is used for decoding data of the M or T function.

●Format

●Control conditions

ACT = 0: Reset all the output data bits.

= 1: Compare the values in IN with one of the eight consecutive data started with BASE. If they are equal, the corresponding bit in the output address (OUT) is set to 1.

●Parameters

SIZE: Specifies the size of IN1 address (1, 2, 4 bytes)

IN : Start address of decoding. The addresses are R, X, Y, F, G, K, A, D, T, C, DC and DT etc.

BASE: Compares the basic values of constants.

OUT: Outputs the comparison results. The addresses are R, Y, G, K and A etc.

●Example:

When X0002.1 =1:

If F0010=8, R0010.0=1 ;

If F0010=9, R0010.1=1 ;

……

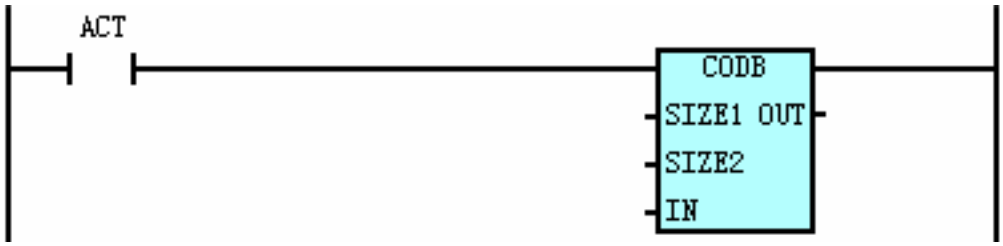
If F0010=15, R0010.7=1

1.4.8 CODB (Binary Code Conversion)

●Function

It converts data in binary format.

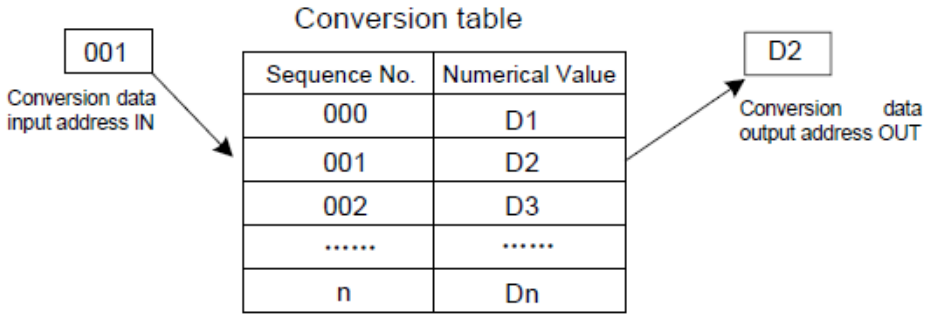
●Format



●Control conditions

ACT = 0: The values in OUT remains unchanged.

= 1: Take the values in “Convert input data address IN” as the sequence number, and obtains the corresponding conversion data from the conversion table, then outputs to the output address (OUT).



●Parameters

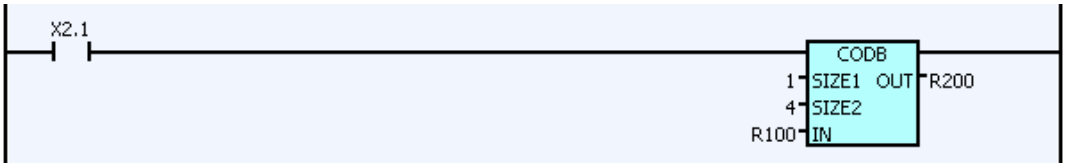
SIZE1: The binary data size and output address size of the conversion data in conversion table (1 byte, 2 bytes, 4 bytes correspondingly).

SIZE2: The size of the conversion table. The size matches with the conversion data.

IN: The input address of conversion data. It only needs one byte data. The addresses are R, X, Y, G, F, A, K and D etc.

OUT: The output address of conversion data. The addresses are R, X, Y, G, F, K, A, D, DT and DC etc.

●Example:



When X0002.1=1,

When X0002.1 = 1, R0100 = 0: R0200 = 1

When X0002.1 = 1, R0100 = 1: R0200 = 2

When X0002.1 = 1, R0100 = 2: R0200 = 3

When X0002.1 = 1, R0100 = 3: R0200 = 4

Conversion Data Table

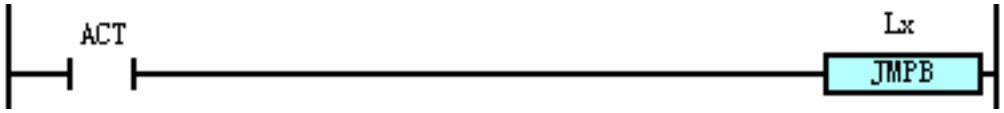
Sequence No.	Numerical Value
000	1
001	2
002	3
003	4

1.4.9 JMPB (Label Jump)

●Function

It transfers control to a Ladder immediately after the label set in a Ladder program. It has following additional functions: more than one jump instruction can be coded for the same label; jump out of subprogram is forbidden; jump forward or backward is available.

●Format



●Control conditions

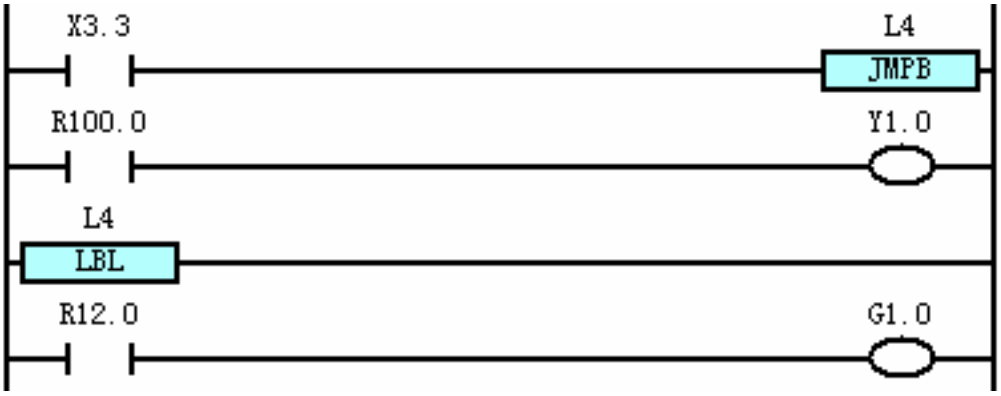
ACT = 0: The next instruction after the JMPB instruction is executed.

= 1: After jump to the specified label, the next instruction after the label is executed.

●Parameters

Lx: Specifies the jump destination. Label number should be started with L address and can be specified one value among L1~L9999.

●Example



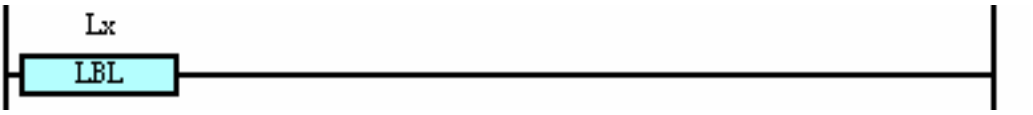
Explanation: When X0003.3 is 1, the program jump over R100.0 and executed from R12.1; if X0003.3 is 0, the execution starts from R100.0.

1.4.10 LBL (Label)

●Function

The LBL function command specifies a label in a Ladder program, i.e. the destination of JUMP. A Lx label can be specified by LBL once.

● Format



●Parameters

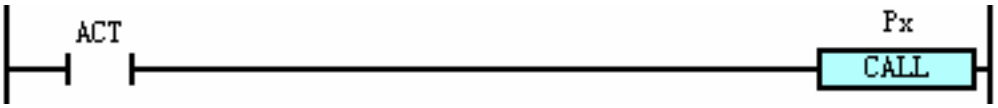
Lx: specifies the jump destination. Label number should start with L address and can be specified one value in L1~L9999.

1.4.11 CALL (Subprogram Call)

●Function

The CALL function command calls the specified subprogram. It has the following features: more than one call instructions can call for the same subprogram; the call instruction can be nested.

● Format



●Control conditions

ACT = 0: The next instruction after CALL is executed

= 1: Call the subprogram which specifies the subprogram number.

●Parameters

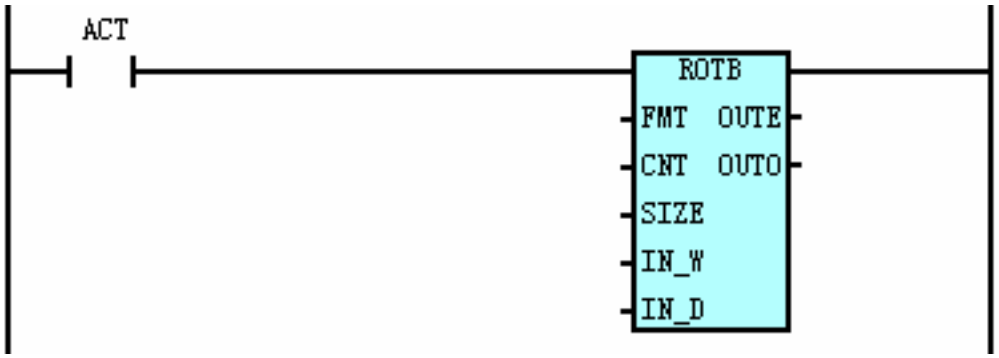
Px: Specifies the subprogram number to be called. The number should be started with P address and can be one value of P1~P9999.

1.4.12 ROTB (Binary Rotation Control)

●Function

It is used to control rotating elements including the tool post, rotary table, etc. The following functions are included: select the rotation direction of the short path; calculate the steps from the current position to destination or the steps from the previous position of current position to that of the object position; calculate the position number of the previous position of the destination.

●Format



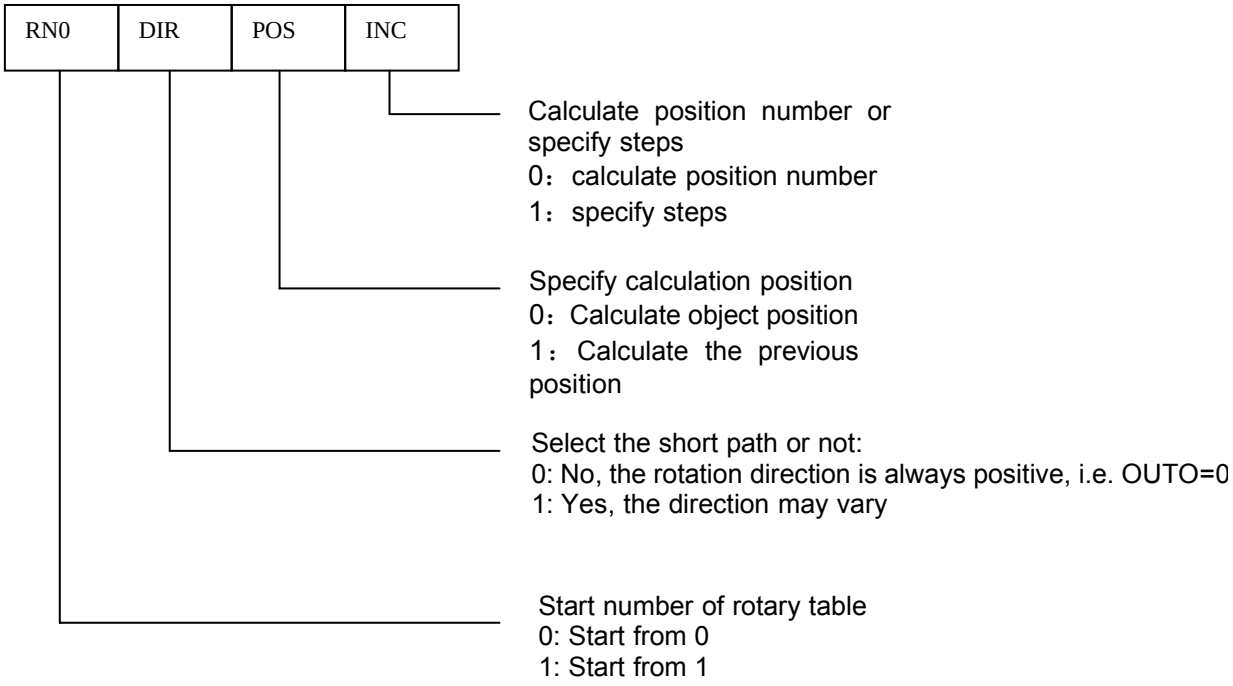
●Control conditions

ACT = 0: The instruction is not executed; OUTE and OUTO remain the same.

= 1: The instruction is executed; the results are output to OUTE and OUTO.

●Parameters

FMT: Data format:



CNT: Rotary table indexing position number.

SIZE: Specify the address size of IN-W, IN-D and OUT (1, 2, 4 bytes).

IN_W: Current position address; it used to store the current position number. The addresses are R, X, Y, F, G, K, A, D, DC, and DT etc.

IN_D: Object position address; it is used to store object position number; the addresses are R, X, Y, F, G, K, A, D, DC and DT etc.

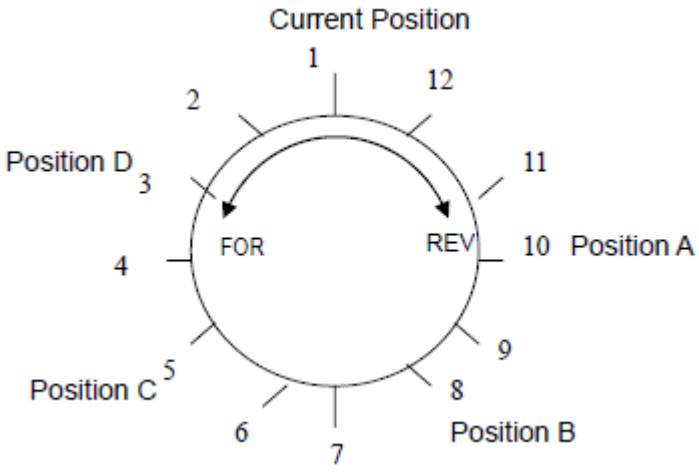
OUTE: Output address of the calculation results. The addresses are R, Y, G, K, A, D, DC and DT

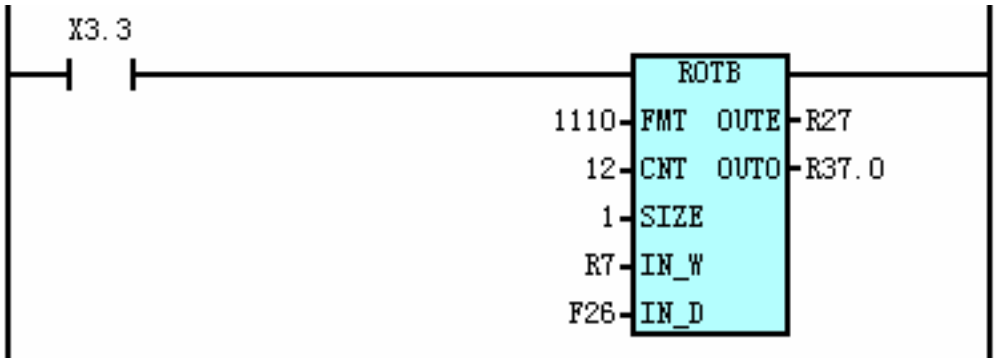
etc.

OUTO: Outputs the rotation direction; If the number given to the rotor is ascending, the rotation is FOR; If descending, REV.When OUTO=0, the rotation direction is positive; when OUTO=1, the rotation is inversed; the addresses are R, Y, G, K and A etc.

●Example

The following figure is a rotary table post. The current tool position is 1.





When the short path rotation is performed, the position number of the previous position before the object position is calculated. The current position number R0007=1, rotary table indexing position number CNT=12, then when X0003.3=1:

F0026 = 10, if the object position is A, R0027 = 11, R0037.0 = 1

F0026 = 8, if the object position is B, R0027 = 9, R0037.0 = 1

F0026 = 5, if the object position is C, R0027 = 4, R0037.0 = 0

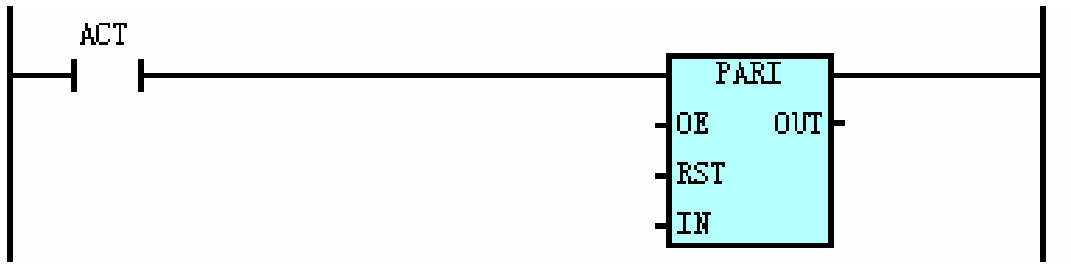
F0026 = 3, if the object position is D, R0027 = 2, R0037.0 = 0

1.4.13 PARI (Parity Check)

●Function

It checks the parity of the input data. Only one-byte of data (8 bits) can be checked.

●Format



●Control conditions

ACT=1: Executes the PARI instruction, performing a parity check. If the input data do not match with the one specified by OE, OUT is 1, otherwise OUT is 0.

ACT=0: Parity checks are not performed. OUT remains the same.

●Parameters

OE =0: Even-parity check

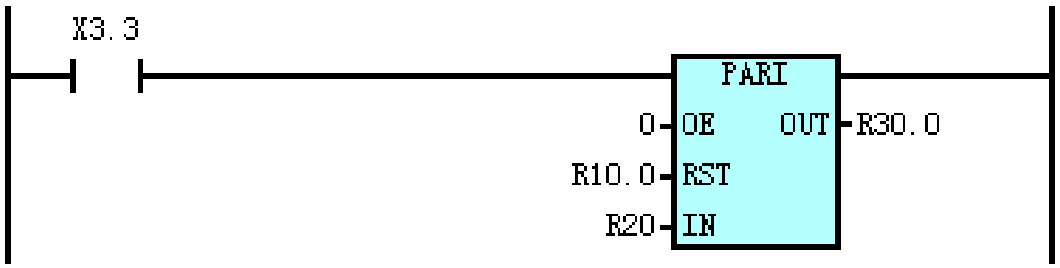
=1: Odd-parity check

RST: RST=1, OUT is reset to 0; the address is X, Y, G, R, F, A, and K etc.

IN: Input data address; the address can be X, Y, G, R, F, A, K and D etc.

OUT: Parity check result output address; it can be Y, G, R, A and K etc.

●Example



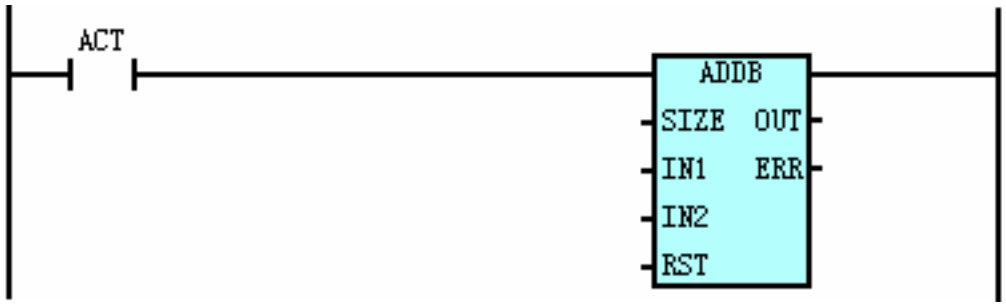
Explanation: If PARI is executed when X0003.3=1, OE=0000, parity check is performed. When R0010.0=1, R0030.0 is reset to 0, parity check is not performed. When R0010.0=0, parity check is performed. R0030.0 is 0 when R0020 data contains even parity; R0030.0 is 1 when R0020 data contains odd parity.

1.4.14 ADDB (Binary Addition)

●Function

It adds the binary data.

●Format



●Control conditions

ACT=1: OUT=IN1+IN2; If error occurs, ERR=1, otherwise ERR=0.

ACT=0: does not execute instruction; OUT and ERR do not change.

●Parameters

SIZE: 1-1 byte, 2-2 bytes 4-4 bytes

IN1: Augend, it can be constant or address. The addresses are R, X, Y, F, G, A, K, D, T, C, DC and DT, etc.

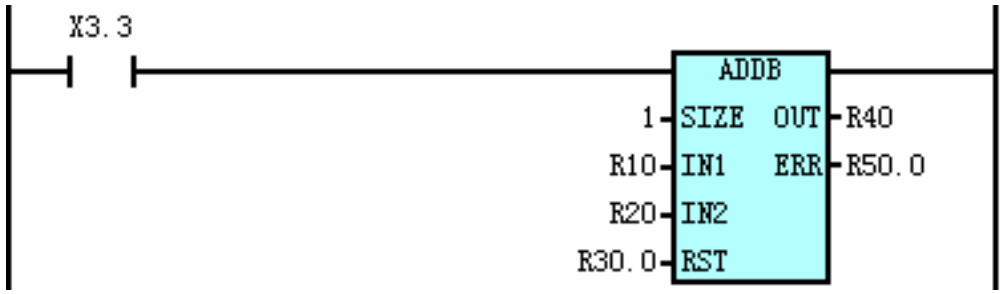
IN2: Addend, it can be constant or address. The addresses are R, X, Y, F, G, A, K, D, T, C, DC and DT, etc.

RST: When RST=1, the ERR is reset to 0, OUT does not change. The addresses are R, X, Y, F, G, A, and K.

OUT: Address of operation result output data. The addresses can be Y, G, R, A, K, DC, DT, D, C and T, etc.

ERR: Address of calculation error output, the addresses can be Y, G, R, A, and K.

●Example



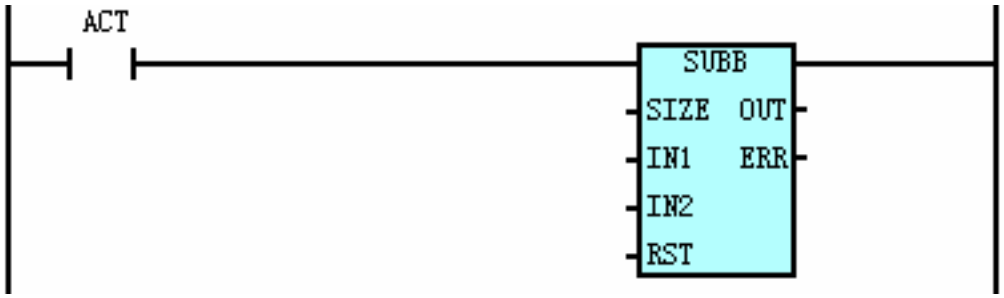
Explanation: When X0003.3=1, ADDB instruction is executed. R0040=R0010+R0020; If the operation is erroneous, R00500.0=1, otherwise R00500.0=0; When R0030.0=1, the state of R0040 remains unchanged, and R0050.0 is reset to 0.

1.4.15 SUBB (Binary Subtraction)

●Function

It subtracts the binary data.

●Format



●Control conditions

ACT=1: OUT= IN1-IN2 is executed; if the operation is erroneous, ERR=1, otherwise ERR=0.

ACT=0: the instruction is not executed. OUT and ERR remain unchanged.

●Parameters

SIZE: 1-1 byte, 2-2 bytes, 4-4 bytes

IN1: Subtrahend; it can be constant or address; the addresses are R, X, Y, F, G, A, K, D, T, C, DC and DT etc.

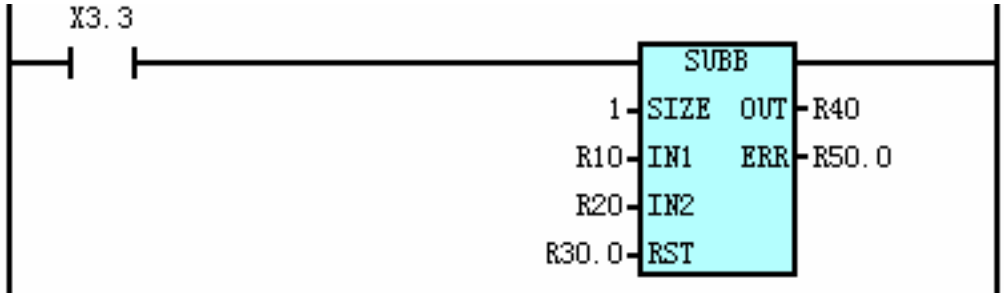
IN2: Subtractor; it can be constant or address; the addresses are R, X, Y, F, G, A, K, D, T, C, DC and DT etc.

RST: When RST=1, ERR is reset. The addresses are R, X, Y, F, G, A and K etc.

OUT: the address of calculation output data. The addresses are Y, G, R, A, K, DC, DT, D, C and T, etc.

ERR: the address of calculation error output. The addresses are Y, G, R, A, and K, etc.

●Example



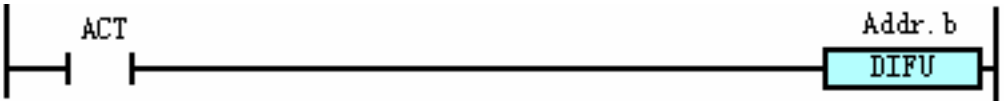
Explanation: When X0003.3=1, SUBB instruction is executed, R0040=R0010-R0020; If the calculation is erroneous, then the R0050.0 is 1, otherwise R0050.0 is 0. When R0030.0 is 1, the state of R0040 remains the same and R0050.0 is reset to 0.

1.4.16 DIFU (Rising Edge Detection)

●Function

It sets the output signal to 1 for one scanning cycle on a rising edge of the input signal.

●Format



●Control conditions

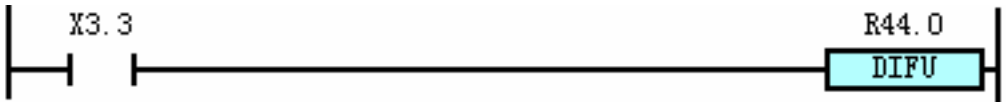
Input signal ACT: On a rising edge (0-1) of the input signal, the output signal is set to 1.

Output signal Addr.b: The output signal level remains at 1 for one scanning cycle of the ladder level where this function command is operating and changes to 0 for next scanning cycle.

●Parameter

Addr.b: calculation output address. It can be Y, G, R, A, and K etc.

●Example



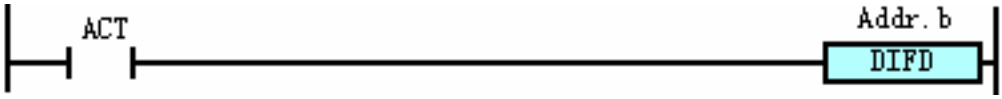
Explanation: When X0003.3 is on rising edge, R0044.0 outputs 1.

1.4.17 DIFD (Falling Edge Detection)

●Function

It sets the output signal to 1 for one scanning period on a falling edge of the input signal.

●Format



●Control conditions

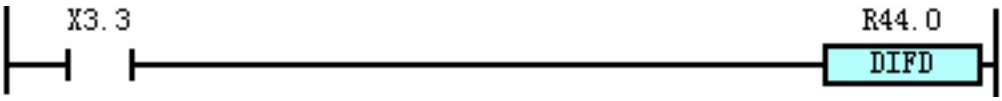
Input signal ACT: On a falling edge (1-0) of the input signal, the output signal is set to 1.

Output signal addr.b: The output signal level remains at 1 for one scanning period of the ladder level where this function command is operating, and for the next scanning period it changes to 0.

●Parameters

Addr.b: the address of calculation output. It can be Y, G, R, A, and K etc.

●Example



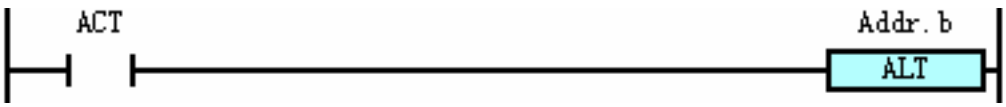
Explanation: When X0003.3 reaches falling edge, the R0044.0 outputs 1.

1.4.18 ALT (Alternative Output)

●Function

It inversely outputs the output signal when the input signal is changing on the rising edge (0-1).

●Format



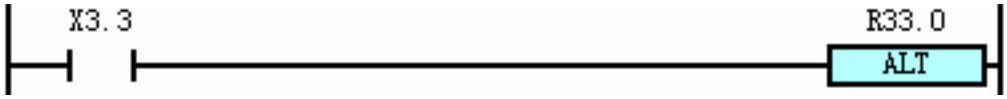
●Control condition

The output signal addr.b is output inversely each time the input signal ACT is changed from 0 to 1.

●Parameters

Addr.b: Output signal address; it can be Y, G, R, A and K etc.

●Example



Explanation: On every rising edge of X0003.3, the state of R0033.0 reverses.

1.4.19 MOVE (Logical Multiplication)

●Function

ANDs logical multiplication data and input data, and outputs the results to a specified address.

●Format

●Control conditions

ACT=1: ANDs logical multiplication data (H, L) and input data (IN), and output the result to the specified address (OUT). It can remove the unnecessary bit from 8-bit signal in the specified address.

ACT=0: Out remains unchanged.

●Parameters

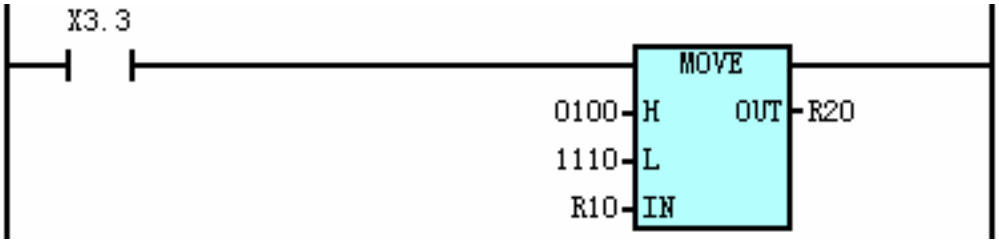
H : High 4-bit logical multiplicator

L : Low 4-bit logical multiplicator

IN : the address of input data; the addresses are R, A, K, X, Y, F, G, and D, etc.

OUT: the address of output data; the addresses are R, A, K, Y, G, and D, etc.

●Example



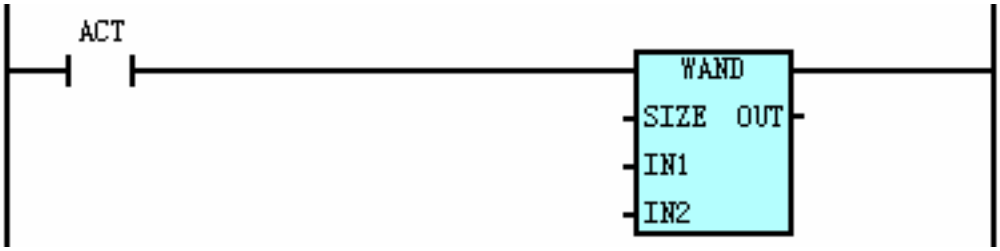
Explanation: When X0003.3 is 1, ANDs the R0010 and 01001110, and stores the result in R0020.

1.4.20 WAND (Binary Byte AND)

●Function

A logical WAND is performed on two input data (1, 2, 4 bytes); the result is output to the OUT.

●Format



●Control conditions

ACT=0: OUT value remains unchanged.

ACT=1: AND is performed on the contents of IN1, IN2, the result is output to OUT.

●Parameters

SIZE: Specifies the size of address IN1, IN2 (1, 2, 4 bytes).

IN1, IN2: The start address or constant of input data, the addresses are R, X, Y, F, G, K, A, D, T, C, DC, DT.

OUT: Address of output result. The addresses can be R, Y, G, K, A, D, T, C, DC, DT.

●Example

Explanation: When X0003.3=1, ANDs the data (8 digits) in X0 and 15 (binary: 00001111), the result is stored in R10. For example, when X0003.0=1, and X0=11000110, after the WAND instruction is executed, the result in R10 is 00000110.

1.4.21 WOR (Binary Byte OR)

●Function

It ORs two input data (1,2, 4 bytes) by bit. The result is output to the OUT.

●Format

●Control conditions

ACT = 0, OUT value remains unchanged.

ACT = 1, ORs the contents of IN1, IN2, and the result is output to OUT.

●Parameters

SIZE: Specifies the size of IN1, IN2 addresses. (1, 2, 4 bytes)

IN1, IN2: The start address or constant of input data. The addresses can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

OUT: The address of output result. The addresses can be R, Y, G, K, A, D, T, C, DC, DT.

●Example

Explanation: When X0003.3=1, ORs the data in X0 (8 digits) and 15 (binary: 00001111), and stores the result in R10. For example, when X0003.3=1 and X0 is 11000110, after the WOR instruction is executed, the result in R10 is 00001111.

1.4.22 WXOR (Binary Byte XOR)

●Function

It XORs two input data (1, 2, 4 bytes) by bit, and outputs the result to OUT.

●Format

●Control conditions

ACT=0, OUT value remains unchanged.

ACT=1, XORs the contents of IN1, IN2, and outputs the results to OUT.

●Parameters

SIZE: Specifies the size of addresses IN1, IN2 (1, 2, 4 bytes)

IN1, IN2: The leading byte of input address or constant of the data. It can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

OUT: The address of result output. The address can be R, Y, G, K, A, D, T, C, DC, DT.

●Example

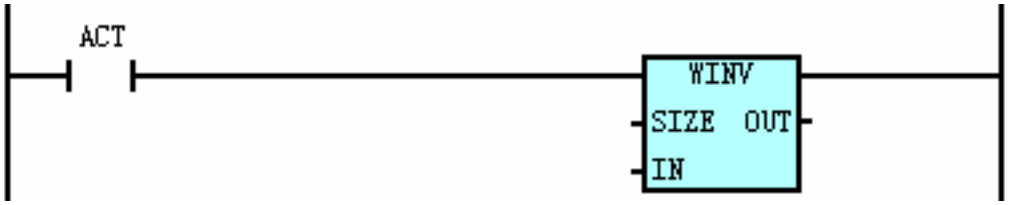
Explanation: When X0003.3=1, XORs the data in X0 (8 digits) and 15 (binary: 00001111), the result is stored in R10. For example, when X0003.3=1 and X0 = 11000110, after the WXOR instruction is executed, the result in R10 is 00001001.

1.4.23 WINV (Binary Byte Inverse)

●Function

It stores the data or constant of input address inversely into the OUT.

●Format



●Control conditions

ACT=0, OUT value remains unchanged.

ACT=1, stores the inversed value of IN into OUT.

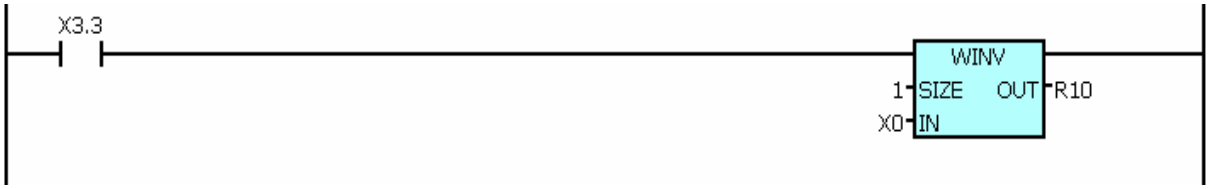
●Parameter

SIZE: The size of data (1, 2, 4 bytes)

IN: The leading byte of input address or constant of the data. The address can be R, X, Y, F, G, K, A, D, T, C, DC DT.

OUT: Output address. It can be R, Y, G, K, A, D, T, C, DC, DT.

●Example



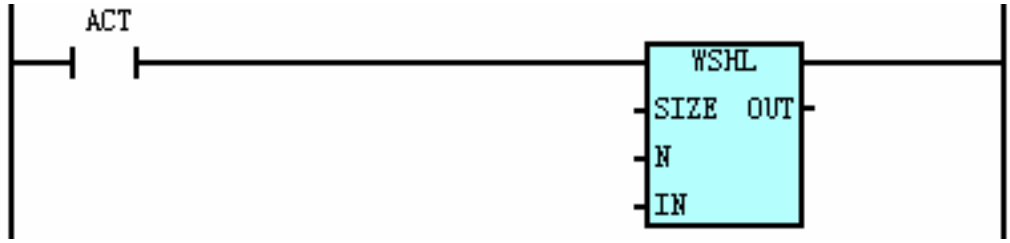
Explanation: When X0003.3=1, inverses the data (8 bits) in X0 and stores the result in R10. For example, when X0003.3=1 and X0=11000110, after the WINV instruction is executed, the result in R10 is 00111001.

1.4.24 WSHL (Binary Data Shift Left)

●Function

It is shift left instruction of two input data (1, 2, 4 bytes) by specified bits. The result is output to the OUT address.

●Format



●Control conditions

ACT=0, OUT value remains the same.

ACT=1, the value in IN is shifted left N bits, and the result is output to OUT.

●Parameters

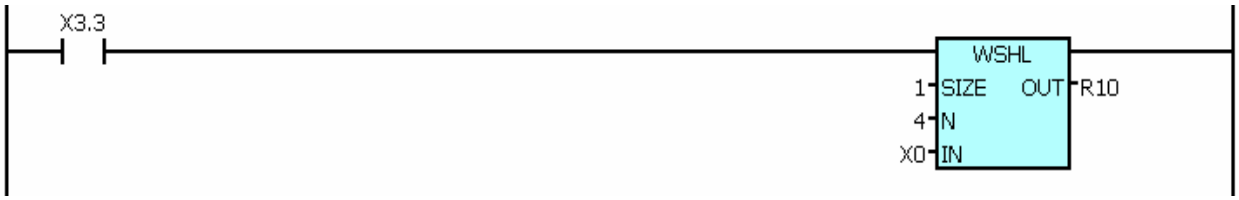
SIZE: Specify the size of data in IN (1, 2, 4 bytes)

N : The address or constant of shifted data. The address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

IN: The leading byte of input address or constant of the data. It can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

OUT: The address of output result. It can be R, Y, G, K, A, D, T, C, DC, DT.

●Example



Explanation: When X0003.3=1, it shifts left 4 bits of the data (8 bits) in X0, and the result is stored in R10. For example, when X0003.3=1, and X0=11000110, after the WSHL instruction is executed, the result in R10 is 01100000.

1.4.25 WSHR (Binary Data Shift Right)

●Function

It is two input data command instructing shift right (1, 2, 4 bytes) in specified bits. The result is output to the OUT.

●Format

●Control condition

ACT=0, OUT value remains the same.

ACT=1, the value in IN is shifted right N bits, and the result is output to OUT.

●Parameters

SIZE: Specify the size of data in IN (1, 2, 4 bytes)

N: The address or constant of shifted data. The address can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

IN: The leading byte of input address or constant of the data. It can be R, X, Y, F, G, K, A, D, T, C, DC, DT.

OUT: The address of output result. It can be R, Y, G, K, A, D, T, C, DC, DT.

●Example

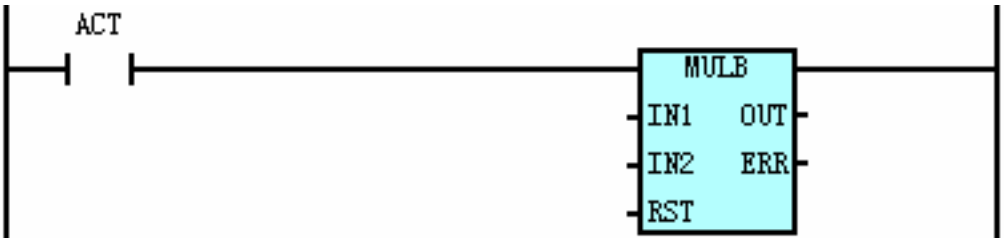
Explanation: When X0003.3=1, it shifts right 4 bits of the data (8 bits) in X0, and the result is stored in R10. For example, when X0003.3=1, and X0=11000110, after the WSHL instruction is executed, the result in R10 is 01100000.

1.4.26 MULB (Binary Data Multiplication)

●Function

It multiplies two input data (16 bits), and the resulted product (32 bits) is stored in the OUT address (32 bit).

●Format



●Control conditions

RST = 0: ERR and OUT remain unchanged.

RST = 1: Reset ERR and OUT.

ACT = 0: OUT value remains unchanged.

ACT = 1: Multiplies the values of IN1 and IN2, the result is output to OUT address.

●Parameters

IN1, IN2: The leading byte of input address or constant of a mulplicator; it can be R, X, Y, F, G, K, A, D, T, C, DC, DT; if single-byte address (8 bits),such as R, X, Y, F, G, K, A, D is used, two consecutive bytes is used as the mulplicator; if double-byte address (32 bits) such as T, C, DC, DT is used, the low 16 bits is used as the mulplicator.

OUT: The address of output result. It can be R, Y, G, K, A, D, T, C, DC, DT.

RST: The input address (bit address) of instruction reset signal

ERR: The output address (bit address) of calculation error. It can be R, Y, G, K, A.

●Example

Explanation: When X0003.3=1, the data consisting R100 and R101 (16 bits, R101 takes up high 8 bits, R100 takes up low 8 bits) is multiplied by constant 40000, and the product is stored in the 4 bytes whose start address is R200 (R200, R201, R202, R203, R200 takes up low 8 bits).

1.4.27 DIVB (Binary Data Division)

●Function

It divides two input data (16 bits) and the results (32 bits including high 16-bit remainder and low 16-bit quotient) are stored in the OUT address (32 bit).

●Format

●Instruction format

DIV	IN1	IN2	RST	OUT	ERR

●Control conditions

RST = 0: ERR and OUT remain unchanged.

RST = 1: Reset ERR and OUT.

ACT = 0: OUT value remains unchanged.

ACT = 1: Divides the values of IN1 and IN2, the result is output to OUT address.

●Parameters

N1, IN2: The leading byte of input address or constant of a mulplicator; it can be R, X, Y, F, G, K, A, D, T, C, DC, DT; if single-byte address (8 bits),such as R, X, Y, F, G, K, A, D is used, two consecutive bytes is used as the divisor; if double-byte address (32 bits) such as T, C, DC, DT is used, the low 16 bits is used as the divisor.

OUT: The address of output result. It can be R, Y, G, K, A, D, T, C, DC, DT.

RST: The input address (bit address) of instruction reset signal

ERR: The output address (bit address) of calculation error. It can be R, Y, G, K, A.

●Example

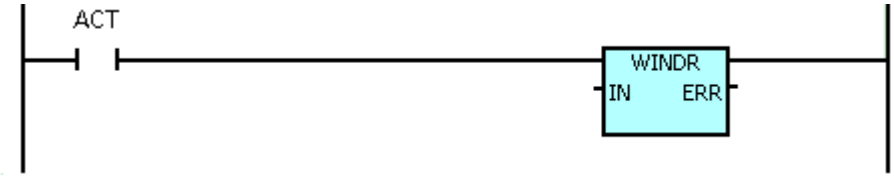
Explanation: When X0003.3=1, it divides the data (16 bits, R101 takes up high 8 bits, R100 takes up low 8 bits) consisted of R100, R101 and constant 1000, and the result is stored in the 4 bytes whose start address is R200 (R200, R201, R202, R203, R200 takes up low 8 bits), the remainder (16 bits) is stored in two bytes (R202, R203, R202 takes up low 8 bits) whose start address is R202.

1.4.28 WINDR (Read the CNC Window Function)

- Function

Create a new window for data delivery between CNC and PLC, and the read-write operations for the multiple-data of the CNC can be peformed by window function.

Ladder diagram formate is as follows:



- Control conditions

ACT=0：Without performing the command, ERR sets to 0.

ACT=1：Perform the command, output the corresponding dataj; ERR sets to 1.

- Relevant parameter

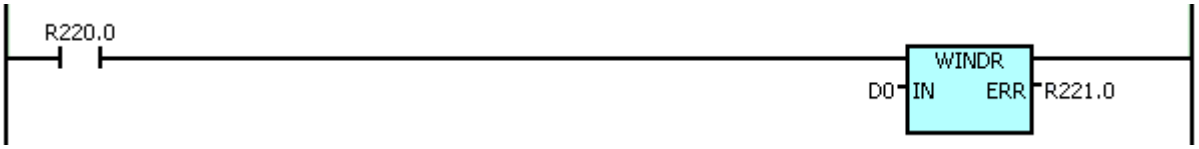
IN：Window initial address; the address is data D.

Read the data (the 6+N data begins with the initial address at the data area of which the N is specified by data length) in its data area when performing the command, and then return the treated data to its data area. There are six data in the data area: function code, end code, data length, data number, data attribution, channel number and data content; the storage formate is as follows:

Initial Add. 0	Function code	Invariable during output
1	End code	
2	Data Size	
3	Data No.	Invariable during output
4	data property	Invariable during output
5	Channel number	Invariable during output
6	data area	

ERR：Function completion output address, the address can be regarded as Y, G, R, K, A, D, C, T, DC and DT. The window command is treated as 0 when it is performed or not performed, and then set it as 1 after execution.

- Example



Explanation: When R220.0=1, read (6+N data, wherein, N is determinded by data length D02) the data into its data area at the beginning of D0, and then return the treated data to its data area. The data area is shown below:

D0000	**Function code**
D0001	**End code**
D0002	Data Size
D0003	**Data number**
D0004	**Data attribution**
D0005	**Channel number**
D0006	data area
…	(It is determined by data length)

- Function code list

Series No.	Function	Function code	R/W
1	Read CNCsystem information	**0**	R
2	Read the tool offset value	**13**	R
3	Write the tool offset value [Low speed response]	**14**	W
4	Read the absolute position of each axis (Absolute coordinate value)	**27**	R
5	Read the mechanical position of each axis (Mechanical coordinate value)	**28**	R

The format and content of each function code

1. Read the system information of the CNC

Read the special information of the CNC. Include the name of CNC, system type, the software version and control axis number.

- Data input

Initial Add.	+0	Function code 0
	1	End code ——
	2	Data Size ——
	3	Data number ——
	4	Data attribution ——
	5	Channel number ——
	6	data area ——

- Data output

Initial Add.	+0	Function ocde 0
	1	End code 0
	2	Data Size 5
	3	Data number ——
	4	Data attribution ——
	5	Channel number ——

6	Data area CNC name	988 series system：988
7	Data area System type	988T：1 988TA：2
8	Data area System series number	
9	Data area Software version	It expresses by decimal system, for example, the value of V1.02 is 102.
10	Data area The No. of controllable axis	It is identical with the current axis number.

2. Read the cutter offset value

Read the offset value, wore value, cutter compensation value and image tool nose number for the cutter.

- Data input

Initial Add.		
	+0	Function code 13
	1	End code ——
	2	Data Size ——
	3	Data number Tool offset number
	4	Data attribution Offset type
	5	Channel number ——
	6	data area ——

- Offset type

	X	Z	Tool nose R	Image too nose	Y
Offset	0	2	4	6	8
Wore	1	3	5	7	9

- Data output

Initial Add.		
	+0	Function code 13
	1	End code End code explanation
	2	Data Size 1
	3	Data number ——
	4	Data attribution

	——
5	Channel number ——
6	Data area Offset data

- The unit of the offset data

Input unit	IS-B	IS-C
Metric	0.001 (mm)	0.0001 (mm)
Inch	0.0001 (inch)	0.00001 (inch)

End code explanation

0: Normally read

3: Disabled for the specified offset number (The offset number exceeds the enabled range 1～99).

4: Disabled for the specified offset type (The offset type exceeds the enabled range).

3. Write the tool offset value (Low-speed response)

Write the offset value, wore value, cutter compensation value and image tool nose number of the cutter

- Data input

Initial Add.	+0	Function code 14
	1	End code ——
	2	Data Size 1
	3	Data number Tool offset number
	4	Data attribution Offset type
	5	Channel number ——
	6	Data area Offset data

- Offset type

	X	Z	Tool nose R	Image tool nose	Y
offset	0	2	4	6	8
wear	1	3	5	7	9

- The unit of offset data

Input unit	IS-B	IS-C
Metric	0.001 (mm)	0.0001 (mm)
Inch	0.0001 (inch)	0.00001 (inch)

- Data output

Initial Add.	+0	Function code 14
	1	End code End code explanation
	2	Data Size 1
	3	Data number ——
	4	Data attribution ——
	5	Channel number ——
	6	Data area ——

End code explanation

0: Normally read

2: Disabled of the specified data length

3: Disabled of the specified offset number (Offset number exceeds the enabled range 1～99).

4: Disabled of the specified offset type (Offset type excceds the enabled range)

6: Disabled data

4. Read the absolute coordinate of each axis (Absolute coordinate value)

Read the absolute coordinate of each axis

- Data input

Initial Add.	+0	Function code 27
	1	End code ——
	2	Data Size ——
	3	Data number ——
	4	Data attribution Axis selection
	5	Channel numer ——
	6	Data area ——

- Axis selection

Aixs	1st	2nd	3rd	4th	5th	Nth	Overall axes
Code	1	2	3	4	5	N	-1

- Data output

Initial Add.		
	+0	Function code 27
	1	End code End code explanation
	2	Data Size Data length explanation
	3	Data number ——
	4	Data attribution ——
	5	Channel number ——
	6	Data area Absolute coordinate

Data length explanation

When the selected axis is arbitary one, the data length is 1.

When the selected axes are the whole axes, the data length is n (n is the Max. axis number).

Absolute coordinate

When the whole selected axes are output, the coordinate data will be output based upon the sequence of the 1st, 2nd, 3rd, 4th and 5th; and the disabled axes are also output.

Absolute coordinate unit

Input unit	IS-B	IS-C
Metric	0.001 (mm)	0.0001 (mm)
Inch	0.0001 (inch)	0.00001 (inch)

End code explanation

1: Normally read

4: The selected axis is disabled.

5. Read the mechanical position of each axis (machine tool coordinate value)

Read the machine tool coordinate of each axis

- Data input

Initial Add.		
	+0	Function code 28
	1	End code ——
	2	Data Size ——
	3	Data number ——
	4	Data attribution Axis selection
	5	Channel number ——
	6	Data area ——

- Axis selection

Axis	1st	2nd	3rd	4th	5th	Nth	Overall axes
Code	1	2	3	4	5	N	-1

- Data output

Initial Add.	
+0	Function code 28
1	End code End code explanation
2	Data Size Data length explanation
3	Data number ——
4	Data attribution ——
5	Channel number ——
6	data area Machine tool coordinate

Data length explanation

When the selected axis is arbitary one, the data length is 1.

When the selected axes are the whole axes, the data length is n (n is the Max. axis number).

Absolute coordinate

Machine tool coordinate

When the whole selected axes are output, the coordinate data will be output based upon the sequence of the 1st, 2nd, 3rd, 4th and 5th; and the disabled axes are also output.

If the system is only used the X, Y and C (5th) axes, the overall axes output will be also performed.

Machine tool coordinate unit

Input unit	IS-B	IS-C
Metric	0.001 (mm)	0.0001 (mm)
Inch	0.0001 (inch)	0.00001 (inch)

End code explanation:

0: Normally read

4: The selected axis is disabled.

Cautions:

(1) During the treatment, it devides into high speed window function and the low one, which is determined by functions. In the low speed window function, the completion of the command may need to scan with more than two circiles, and therefore, it is necessary to hold ACT=1 during the execution of the command in the low speed window, and the controllable data is invarible. Next low speed window command can be performed after resetting the ACT once followed with that the treatment is performed (ERR regards as 1).

In the high speed window function, the command can be performed in the level scan. The next

high window command can be executed regardless of the ACT reset after the treatment is completed (ERR treats as 1). Therefore, the data read-wirte will be consecutively performed when ACT is always sets to 1.

(2) D address data length is 32-bit, and its resolution range is -2147483647～2147483647; the data in the window function are regarded the D address data length as a unit, that is, a 4-byte. The address adds 1 in the data arrangement, namely, the data address moves afterwards 4 bytes; if the data length adds 1, namely, the data length adds 4 bytes.

(3) It is not confirmed the length of data area in the window function, and it is necessary to reserve adequate space for the data area against the error of the operation when the PLC program is compiled

(4) The channel number is only used in the dual-channel system; the standard system is the reserved data, which is not input. (When the channel number in the dual-channel system is set to 1, it not input too.)

(5) When ERR sets to 1, which means that the window function treatment is performed, however, it does not manifest that the data treatment is successful. The current performed state can be judged only from the output code. The meaning of the end code is as follows:

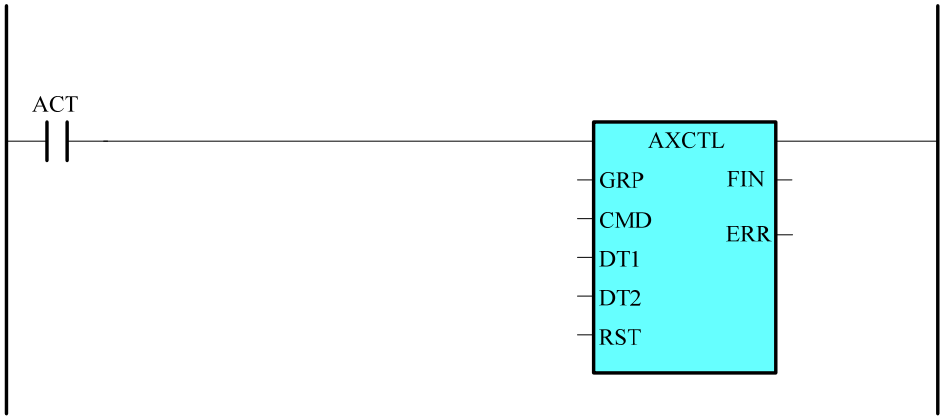
End code	Meaning
0	Normal end
1	Function code disabled
2	Data lock length disabled
3	Data number disabled
4	Data attribution disabled
5	Channel number disabled
6	Data disabled
7	Without the corresponding function
8	Write protection state

1.4.29 AXCTL（PLC Axis Control Function）

- Function

  Perform the PLC axis controllable command

- Format



ACT=0: Do not perform the AXCTL command

ACT=1: Perform the AXCTL command, and the ACT should be hold as 1 till to the end of the axis controllable command. To guard against the repeated performance, immediately rest the ACT after the performance is ended (FIN=1).

- Parameter explanation

Parameter name	Parameter meaning	Data type
GRP	DI/DO group numbers (1~4) It corresponds with the parameter #8010; if one axis setting value is identical with the GRP, and then this axis is controlled.	Constant or X,Y,F,G,R,K,A,D,C,T,DC,DT (Byte address)
CMD	Controllable command. Refer to the PLC axis controllable command list for detailed.	Constant or X,Y,F,G,R,K,A,D,C,T,DC,DT (Byte address)
DT1	Command datum 1 is corresponds with the concrete controllable command.	Constant or X,Y,F,G,R,K,A,D,C,T,DC,DT (Byte address)
DT2	Command datum 2 corresponds with the concrete controllable command.	Constant or X,Y,F,G,R,K,A,D,C,T,DC,DT (Byte address)
RST	Restting input bit RST=1: Command is cleared; execution is stopped It is suggested to set the RST when CNC alarms or CNC resets.	X,Y,F,G,R,K,A (Bit address)
FIN	End signal output position FIN=0: It does not perform or it is being performed. FIN=1: When the axis controllable command is performed (the normal end or error included)	Y,G,R,K,A (Bit address)
ERR	Command performance error output ERR=0: Without error ERR=1: Execution error	Y,G,R,K,A (Bit address)

- Performance procedure and the relevant signal

In order to brief the described procedure and easily to understand, the parameter and PLC signal involoved in this section are briefily explained, actually, it is better to check the parameter explanation and PLC signal files when using, so that the detailed cautions can be comprehended..

- Parameter setting

Which DI/DO controls the PLC axis that is set by parameter №8010, set the parameter based upon the following explanation.

8010	**Selecting each axis DI/DO group controlled by PLC**

[Parameter Type] Word axis type

[Value Range] 0～4

Each DI/DO group controlled by each PLC axis, which is shown as the following list:

NUMERICAL VALUE	REMARK
0	The axis is not controlled by PLC
1	DI/DO in group A is used
2	DI/DO in group B is used
3	DI/DO in group C is used
4	DI/DO in group D is used

- Signal enabling

Perform the AXCTL command cable, the controllable axis selection signals (EX1～EX5) of its corresponding one are set to 1, the signal address is G136, as follows:

	#7	#6	#5	#4	#3	#2	#1	#0
G136				EAX5	EAX4	EAX3	EAX2	EAX1

[Type] Sigal input

[Function] When the signal is set to 1, the corresponding axis is controlled by PLC.

When the signal is set to 0, PLC control is disabled.

Note: The time from setting the control axis selection signals EAX1~EAX5 to 1 to PLC forwarding instructions to CNC should be 8ms at least.

- AXCTL performance procedure

The AXCTL procedure described in the following items are performed inside the AXCTL, which does not need to compile this procedure or read/write its relevant signal; in this case, the user can easily debugged the diagnosis after comprehending its relevant procedure.

1. When ACT changes into 1 from 0, AXCTL will perform the follow operations:

a) CMD fills the axis controllable command register (from EC0g to EC6g).

b) DT1 fills axis controllable feedrate register (from EIF0g to EIF15g).

c) DT2 fills axis controllable data register (from EID0g to EID15g).

d) Reverse axis controllable read signal EBUFg.

Relevant information address

DI/DOgroup	Command register EC0g-EC6g	Speed register EIF0g-EIF15g	Data register EID0g-EID15g	Axis control Command Read Signal EBUFg
1	G141.0-G141.6	G142 and G143	G144 and G145	G140.7
2	G151.0-G151.6	G152 and G153	G154 and G155	G150.7
3	G161.0-G161.6	G162 and G163	G164 and G165	G160.7
4	G171.0-G171.6	G172 and G173	G174 and G175	G170.7

2. When ACT is always held as 1, PLC controllable command maintains to perform. Each PLC cycle of AXCTL detects the performance state of the command once; the following states will be checked:

a) Command execution end is inquired of which the FIN sets to 1; otherwise, it holds as 0.

b) Execution error or alarm is inquired of which the ERR sets to 1; otherwise it sets to 0.

c) When RST=1 is inquired, the axis controllable resetting signal EXLRg sets to 1, simultaneously, the FIN is set to 1, too.

3. When the ACT turns into 0 from 1, AXCTL is interrupted; the treatments of different states are shown below:

a) Both FIN and ERR are set to 0 regardless of which performance result.

b) If the current axis controllable command does not complete, the program end signal ESBKg sets to 1.

- Relevant information address

DI/DOgroup	Reset signal ECLRg	Stop signal ESBKg
1	G140.6	G140.3
2	G150.6	G150.3
3	G160.6	G160.3
4	G170.6	G170.3

- Axis control command list

Operation	Command code (CMD)	Command Data 1 (DT1)	Command Data 2 (DT2)
Rapid traverse	0x00	Feedrate When parameter #8002.0=0, regardless of this value. The speed is determined by system parameter.	The total move distance
Cutting feed (Feed per minute)	0x01	Feedrate	The total move distance

Cutting feed (Feed per rotation)	0x02	Feedrate	None
Dwell	0x04	None	Dwell time
Reference point return	0x05	None	None
Continuous feed	0x06	Feedrate	Feed direction
The 1st reference point return	0x07	Feedrate; when #8002.0=0, regardless of this value. Speed is determined by system.	None
The 2nd reference point return	0x08		
The 3rd reference point return	0x09		
The4th reference point return	0x0A		
Speed command	0x10	Feedrate	None
The 1st miscellaneous function	0x12		
The 2nd miscellaneous function	0x14		
The 3rd miscellaneous function	0x15		
Machine coordinate system setting (G53)	0x20	Feedrate When #8002.0=0, regardless of this value. The speed is set by system parameter.	Machine coordinate system setting (absolute value)

CHAPTER 2 PLC SIGNALS

2.1 Control Axes

2.1.1 Axes Moving Status

NC can be sent the current axis moving status to PLC, and then PLC works according to the status.

2.1.1.1 Axes Moving Signals

MV1 ~ MV5 (F102.0 ~ F102.4)

●Signal type: NC→PLC

●Signal function: MV1, MV2, MV3, MV4, MV5 are moving signals for axis 1, 2, 3, 4 ,5 respectively. When an axis is moving, NC sets corresponding axis moving signal to 1. When an axis stops moving, the axis moving signal is 0. PLC works according to the received signal.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F102				MV5	MV4	MV3	MV2	MV1

2.1.1.2 Axis Moving Direction Signal

MVD1 ~ MVD5 (F106.0~F106.4)

●Signal type: NC→PLC

●Signal function: MVD1, MVD2, MVD3, MVD4, MVD5 are axis moving direction signal for axes 1,2, 3, 4, 5 respectively. When an axis is moving backward, NC sets the axis moving direction signal to 1; when an axis is moving forward, the axis moving direction signal is 0; if an axis stops moving, the signal will be 1 or 0 according to the moving status before the axis stops.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F106				MVD5	MVD4	MVD3	MVD2	MVD1

2.1.2 Servo Ready Signal

SA (F0.6)

●Signal type: NC→PLC

●Signal function: When NC issues an alarm by receiving an alarm signal from the servo system, it sets SA signal to 0, and informs the PLC that the servo system is not ready and

the axis cannot move. When the warning is cancelled, NC sets SA to 1 to move axis again.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F0		SA						

2.2 Operation Preparation

2.2.1 Emergency Stop

Emergency stop signal ESP(G8.4):

●Signal type: PLC→NC; valid when it is 0.

●Signal function: When G8.4 is 0 level, NC detects the signal and issues an emergency stop alarm.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8				ESP				

2.2.2 CNC Ready Signal

MA (F1.7):

●Signal type: NC→PLC

●Signal function: This signal indicates the CNC is ready for operation.

●Output condition: After power-on, this signal is set to 1 (usually in a few seconds); if an alarm occurs in CNC or emergency stop is executed, this signal changes to 0.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1	MA							

2.2.3 Alarm Signal

AL(F1.0):

●Signal type: NC→PLC

●Signal function: When CNC issues an alarm, the alarm will be displayed on the screen and AL is set to 1; after PLC receives this signal, there are three kinds of alarms to be displayed according to the alarm signal status: servo alarm, P/S alarm, overtravel alarm. When CNC is reset, the alarm is cleared and AL is set to 0.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1	MA							

2.2.4 Mode Selection

Mode selection signals include MD1, MD2, MD4, DNC1 and ZRN. Six working modes are available: EDIT mode, AUTO mode, MDI mode; JOG mode, HANDLE/INC mode and REF mode. CNC detects signals by outputting the working mode and informs PLC the current working mode.

2.2.4.1 Mode Selection Signal

MD1, MD2, MD4 (G43.0 ~ G43.2) DNC1(G43.5) ZRN(G43.7):

●Signal type: PLC→NC

●Signal function: The code signal of working mode is shown as follows:

No.	Code Signal / Working Mode	ZRN	DNC1	MD4	MD2	MD1
1	EDIT mode	0	0	0	1	1
2	AUTO mode	0	0	0	0	1
3	MDI mode	0	0	0	0	0
4	HANDLE/INC mode	0	0	1	0	0
5	JOG mode	0	0	1	0	1
9	Machine reference point return (REF) mode	1	0	1	0	1

PLC assigns values to the code signals after receiving the input signal of working mode, and then, sends it to NC. NC determines the CNC working mode according to the code signal.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G43	ZRN		DNCI			MD4	MD2	MD1

2.2.4.2 Working Mode Check Signal

MINC (F3.0), MH (F3.1), MJ (F3.2), MMDI (F3.3), MRMT (F3.4), MMEM (F3.5), MEDT (F3.6), MREF (F4.5)

●Signal type: NC→PLC

●Signal function: When CNC is in a certain working mode, the corresponding F signal is set to 1 and then sent to PLC; PLC works according to the working mode check signal.

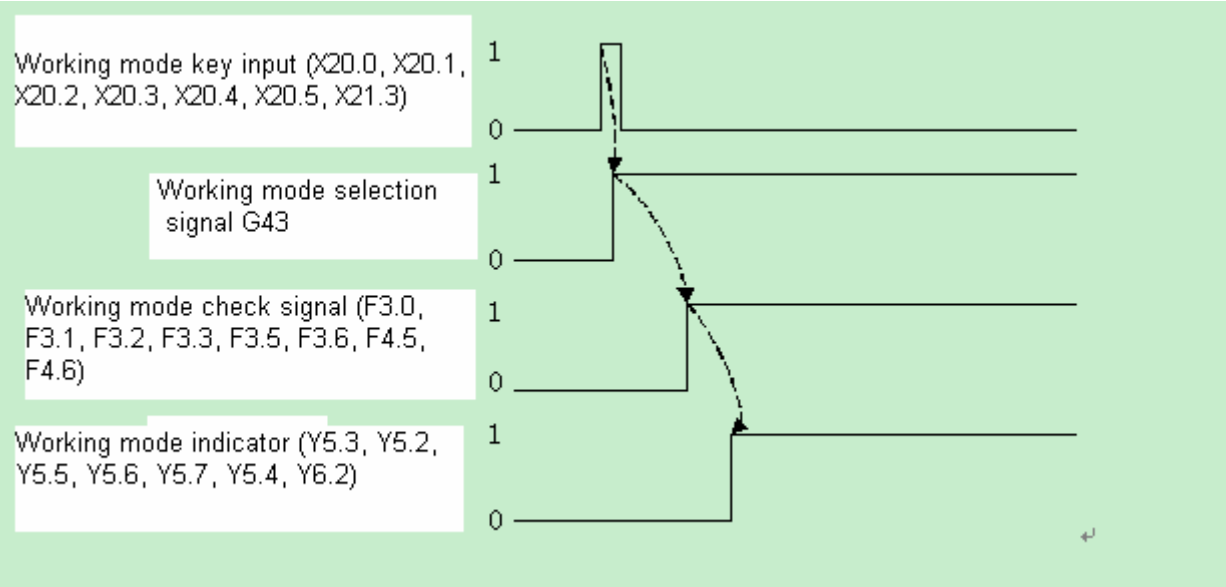
INC mode check signal	MINC
MPG mode check signal	MH
JOG mode check signal	MJ
MDI mode check signal	MMDI

DNC mode check signal	MRMT
AUTO mode check signal	MMEM
EDIT mode check signal	MEDT
REF mode check signal	MREF

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F3		MEDT	MMEM	MRMT	MMDI	MJ	MH	MINC
F4			MREF					

2.2.4.3 Working Mode Signal Sequence



2.2.5 Status Output

Rapid traverse signal

RPDO (F2.1):

●Signal type: NC→PLC

●Signal function: When CNC is in MANUAL rapid traverse mode, axis movement is executed and RPDO is set to 1.

●Note: RPDO is 1 during rapid traverse and the status remains the same when the feed stops.

When a mode other than rapid traverse is selected, RPDO signal is reset to 0 after the axis moves.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2							PRDO	

2.2.6 Overtravel Detection

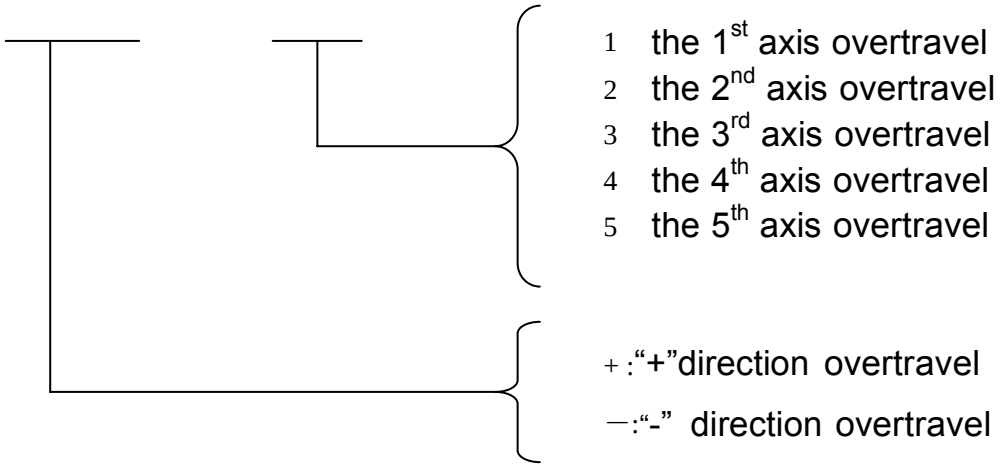
2.2.6.1 Overtravel Signal

+L1 ~ +L5(G114#0~G114#4) , -L1 ~ -L5(G116#0~G116#4)

●Signal type: PLC→NC

●Signal function: It indicates that the control axis has reached the stroke limit; every direction of each axis has such signal; the symbol "+" or " - " represents the direction, and the numbers correspond to the control axis.

＋ L 1


1 the 1st axis overtravel
2 the 2nd axis overtravel
3 the 3rd axis overtravel
4 the 4th axis overtravel
5 the 5th axis overtravel
+ :"+"direction overtravel
－:"-" direction overtravel

[Motion] When the above signals are 0, the motion of control unit is as follows:

*In AUTO mode, even only one axis overtravel signal changes to 0, all the axes will decelerate and stop, and an alarm is issued. The running is stopped.

*In MANUAL mode, only the corresponding axis stops, and the axis can move reversely after stop.

*The moving direction is stored as long as the overtravel signal becomes 0, and the direction is invalid before the alarm is cleared even if the signal turns into 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G114				+L5	+L4	+L3	+L2	+L1
G116				-L5	-L4	-L3	-L2	-L1

2.2.6.2 Stored Stroke Check 1

Stored stroke check selection signal

EXLM (G7.6)

●Signal type: PLC→NC

●Signal function: When the signal is 1, parameters No.1326 and No.1327 are used to perform stroke check 1; when the signal is 0, parameters No.1320 and No.1321 are used to perform stroke check 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G7		EXLM						

2.2.6.3 Stored Stroke Check 2, 3

Stored stroke check 3 release signal

RLSOT3 (G7.4)

●Signal type: PLC→NC

●Signal function: It determines whether stored stroke check 3 is performed. When the signal is 1, the stored stroke check 3 is not performed; when the signal is 0, and parameters No.1300.5 and No.1310.1 are 1, the stored stroke check 3 is performed.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G7				RLSOT3				

2.3 Manual Operation

2.3.1 Manual Feed/Incremental Feed

Manual feed: In MANUAL mode, when the feed axis signal and direction selection signal on the operation panel are set to 1, the tool continuously moves on the selected axis along the selected direction.

Incremental feed: In incremental mode, when the feed axis signal and direction selection signal on the operation panel are set to 1, the tool moves one step on the selected axis along the selected direction. The minimum movement distance is the least input increment. Four override values (0.001, 0.010, 0.100, 1.000) are available.

The only difference between manual feed and incremental feed is the way of selecting feed distance. In manual feed, when the feed axis signals and direction selection signals (+ J1, - J1, + J2, - J2, + J3, - J3) are 1, the tool can feed continuously. In incremental feed, the tool feeds in steps.

When manually turn ON the rapid traverse, the tool feeds at the rapid traverse speed. In incremental feed mode, the step distance can be selected by MP1, MP2.

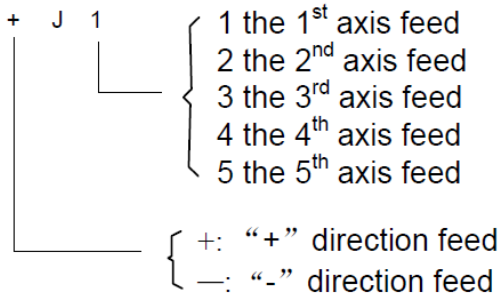
2.3.1.1 Feed Axis signal and Direction Selection Signal

+ J1 ~ + J5 (G100.0 ~ G100.4), - J1 ~ - J5 (G102.0 ~ G102.4)

●Signal type: PLC→NC

●Signal function: It selects the feed axis and direction in manual feed mode or incremental feed mode. NC sets the corresponding axis and direction selection signal to 1, and PLC

proceeds the control after receiving the signal. Symbol "+" or "-" indicates the feed direction. The number corresponds to the control axis.


+ J 1
1 the 1st axis feed
2 the 2nd axis feed
3 the 3rd axis feed
4 the 4th axis feed
5 the 5th axis feed
+: "+" direction feed
—: "-" direction feed

●Note: A: In manual feed, CNC makes the selected axis moving continuously. In the incremental feed mode, CNC makes the selected axis moving according to the specified rate defined by MP1, MP2 signals.

B: When an axis is moving, NC sets the axis and direction selection signal to 1. When the axis stops moving, the signal changes to 0.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G100				+J5	+J4	+J3	+J2	+J1
G102				-J5	-J4	-J3	-J2	-J1

2.3.1.2 Manual Feed Override Signal

JV00 ~ JV15(G10, G11):

●Signal type: PLC→NC

●Signal function: It selects the manual feed override. The following table shows the relationship between signals and manual feed override. PLC sets value to G10, G11 and transmits it to NC after receiving the external override input signal. CNC displays the corresponding feedrate.

G11	G10	Override (%)
0000 0000	0000 0000	0
0000 0000	0000 0001	10
0000 0000	0000 0010	20
0000 0000	0000 0011	30
0000 0000	0000 0100	40
0000 0000	0000 0101	50
0000 0000	0000 0110	60
0000 0000	0000 0111	70
0000 0000	0000 1000	80
0000 0000	0000 1001	90
0000 0000	0000 1010	100
0000 0000	0000 1011	110
0000 0000	0000 1100	120
0000 0000	0000 1101	130

0000 0000	0000 1110	140
0000 0000	0000 1111	150

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G10	JV7	JV6	JV5	JV4	JV3	JV2	JV1	JV0
G11	JV15	JV14	JV13	JV12	JV11	JV10	JV9	JV8

2.3.1.3 Rapid Traverse Selection Signal

RT (G19.7)

●Signal type: PLC→NC

●Signal function: It selects the rapid traverse speed in manual mode. PLC sets RT to 1 after receiving the manual rapid traverse input signal, and transmits it to NC.
During manual rapid traverse, when RT is switched from 1 to 0 or from 0 to 1, the feedrate reduces to 0, and then increases to the specified value. During acceleration/deceleration, the status of feed axis signal and direction selection signal remain unchanged.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G19	RT							

2.3.2 MPG Feed

In MPG feed mode, the tool can be minutely moved by rotating the handle. An axis can be selected according to the MPG axis selection signal.

2.3.2.1 MPG Feed Axis Selection Signal

HS1A ~ HS1D (G18.0 ~ G18.3), HS2A ~ HS2D (G18.4 ~ G18.7)

●Signal type: PLC→NC

●Signal function: It selects the MPG feed axis. PLC assigns values to HSnA ~ HSnD after receiving the MPG feed axis input signal. NC selects the corresponding axis according to the HSnA ~ HSnD signal status. The relationship between these signals and MPG feed axis is shown as follows:

HSnD	HSnC	HSnB	HSnA	Feed Axis
0	0	0	0	None
0	0	0	1	Axis1
0	0	1	0	Axis 2
0	0	1	1	Axis 3
0	1	0	0	Axis 4
0	1	0	1	Axis 5

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G18	HS2D	HS2C	HS2B	HS2A	HS1D	HS1C	HS1B	HS1A

2.3.2.2 MPG Override Signal

MP1 (G19.4), MP2 (G19.5):

●Signal type: PLC→NC

●Signal function: During the MPG feed, it selects the magnification of the manual MPG feedrate corresponding to each pulse which is generated by the MPG. PLC assigns values to MP1, MP2 after receiving the MPG override (×1, ×10, ×100, ×1000) input signal, and transmits it to NC. The relationship between MP1, MP2 and the MPG override is shown in the following table:

MP2	MP1	Override	Movement amount
0	0	1	Least input increment ×1
0	1	10	Least input increment ×10
1	0	Set by parameter No. 7113	Least input increment × the value of parameter NO.7113
1	1	Set by parameter No. 7114	Least input increment × the value of parameter NO.7114

Note: Besides setting the MPG override, the system parameter No.NO.7103#2 HNT is also used to set whether to magnify 10 times (10 times magnification when the HNT is set to 1) of the movement amount of the incremental feed/MPG feed. The table above is calculated when HNT is set to 0.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G19			MP2	MP1				

2.4 Machine Reference Point Return

2.4.1 Machine Reference Point Return

In machine reference point return mode, the feed axis signal and direction selection signal are set to 1, and the tool moves along the setting direction and returns to machine zero point. After the tool returns to the machine reference point, CNC sets a workpiece coordinate system according to parameter No. 1240~1243.

2.4.1.1 Machine Reference Point Return Completion Signal

ZP1 ~ ZP5(F94.0 ~ F94.4), ZP21 ~ ZP25(F96.0 ~ F96.4)

ZP31 ~ ZP35(F98.0 ~ F98.4), ZP41 ~ ZP45(F100.0 ~ F100.4)

●Signal type: NC→PLC

●Signal function: When an axis ends the machine reference point return, NC sets the corresponding F signal to 1, and transmits it to PLC. PLC proceeds logic control accordingly. ZPn1、ZPn2、ZPn3、ZPn4、ZPn5 signals are machine reference point return completion signals for axes 1, 2, 3, 4 ,5 respectively.

●Notes: When machine reference point return has already completed (and G28 command returns to zero), and the current position is within the specified area, the machine reference point return completion signal changes to 1. When the tool moves away from machine reference point or when an emergency or drive unit alarm is issued, the machine reference point return completion signal changes to 0.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F94				ZP5	ZP4	ZP3	ZP2	ZP1
F96				ZP25	ZP24	ZP23	ZP22	ZP21
F98				ZP35	ZP34	ZP33	ZP32	ZP31
F100				ZP45	ZP44	ZP43	ZP42	ZP41

2.4.1.2 Machine Reference Point Setting Signal

ZRF1 ~ ZRF5(F120.0 ~ F120.4)

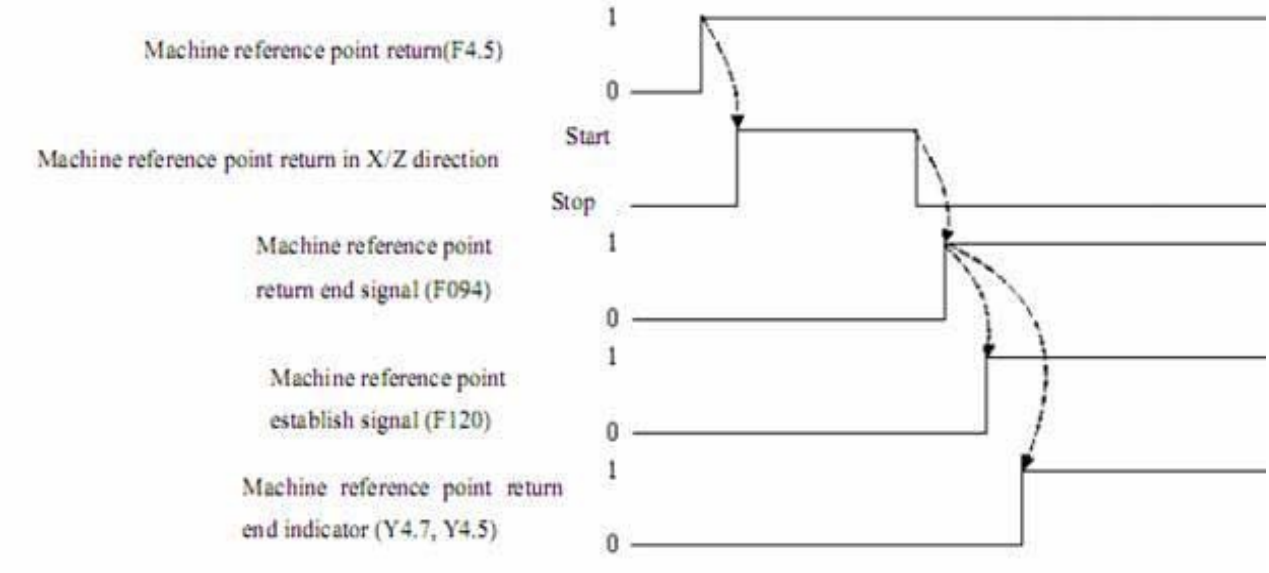
●Signal type: NC→PLC

●Signal function: After the machine reference point return is executed and the machine reference point is set, the corresponding machine reference point setting signal is set to 1, and then this signal is transmitted to PLC. PLC proceeds logic control according to the status of the reference point setting signal. ZRF1, ZRF2, ZRF3, ZRF4, ZRF5 are the signals corresponding to axes 1, 2, 3, 4, 5.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F120				ZRF5	ZRF4	ZRF3	ZRF2	ZRF1

2.4.1.3 Sequence of Machine Reference Point Signal



2.5 Automatic Operation

2.5.1 Cycle Start/Feed Hold

●Cycle start (start automatic operation)

In AUTO or MDI mode, when the automatic operation start signal ST is enabled, program starts running.

1. Signal ST is ignored under the following conditions:

A: The system is in a mode other than AUTO or MDI mode. B:
Feed hold signal SP is 0.
C: Emergency stop signal ESP is 0. D:
External reset signal ERS is 1.
E: The “RESET” key on the operation panel is pressed. F:
CNC is in alarm state.
G: Automatic operation is already started. H:
Program reset signal SRN is 1.
I : CNC is searching for a sequence number.

2. During automatic operation, the CNC performs feed hold under the following conditions: A:
The feed hold signal SP is 0.
B: The AUTO mode is switched to other modes (MANUAL, HANDWHEEL, STEP, MACHINE REFERENCE RETURN, PROGRAM REFERENCE RETURN modes)
C: During single block execution, the instruction for the single block is finished. D:
The operation is finished in MDI mode.
E: An alarm occurs in CNC system.

F: After the AUTO mode is switched to EDIT mode, the single block instruction is finished.

3. During automatic operation, CNC enters into reset state and stops running under the following conditions:

A: Emergency stop signal ESP is set to 0. B:

External reset signal ERS is 1.

C: “RESET” key on the operation panel is pressed.

●Feed hold (automatic operation interrupted)

During automatic operation, when the feed hold signal SP is 0, CNC enters into paused state and stops running. Meanwhile, cycle start indicator STL is set to 0, and feed hold signal SPL is set to 1. Even if SP is set to 1 again, the automatic operation will not be re-started. Only when SP is set to 1 and ST signal is valid, can the machine be restarted and operated automatically.

During the execution of blocks containing M, S, T function instructions, SP signal is set to 0, STL will be 0 immediately, SPL signal is 1, and CNC enters into paused state. When receiving FIN signal from PLC, CNC continues executing the interrupted blocks. After the block is executed, SPL signal is set to 0 (STL signal is 0), CNC enters into automatic operation paused state.

2.5.1.1 Cycle Start Signal

ST (G7.2):

●Signal type: PLC→NC; falling edge is valid

●Signal function: In AUTO or MDI mode, when PLC receives the input signal of cycle start on the panel, G7.2 is set to 1 at first, then set to 0 and transmitted to NC, the automatic operation is started.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G7						ST		

2.5.1.2 Feed Hold Signal

SP (G8.5)

●Signal type: PLC→NC, valid when it is 0.

●Signal function: PLC sets G8.5 to 0 after receiving this signal, and transmits it to NC. The automatic operation is stopped. When the SP input signal is 0, the automatic operation cannot be started.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G8			SP					

2.5.1.3 Cycle Start Signal

STL (F0.5)

●Signal type: NC→PLC

●Signal function: CNC sets STL to 1 during automatic operation and then transmits it to PLC; PLC proceeds logic control according to the state of STL.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0			STL					

2.5.1.4 Feed Hold Signal

SPL (F0.4)

●Signal type: NC→PLC

●Signal function: CNC sets SPL to 1 when it is in paused state, and then transmits it to PLC. PLC starts logic control according to the state of SPL.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0				SPL				

2.5.1.5 Automatic Operation Signal

OP (F0.7)

●Signal type: NC→PLC

●Signal function: CNC sets OP to 1 during automatic operation and then transmits it to PLC. PLC works according to the state of OP.

	Cycle start indicator STL	Feed hold indicator SPL	Automatic operation indicator OP
Cycle start state	1	0	1
Feed hold state	0	1	1
Automatic operation paused state	0	0	0
Reset state	0	0	0

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0	OP							

2.5.2 Reset/ External Workpiece Index

Under the following conditions, CNC enters into reset state: A:

Emergency stop signal ESP is set to 0.

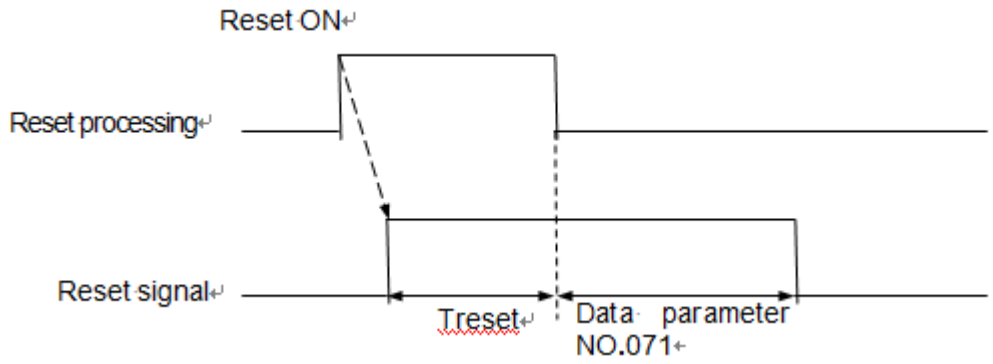
B: External reset signal ERS is 1.

C: “RESET” key on the operation panel is pressed.

Under other conditions, reset signal RST is changed to 0 after the time set by parameter No. 071 has passed.

RST time =T reset (reset processing time) + the setting value of data parameter No.071

During automatic operation, when CNC is reset, the operation stops and control axis decelerates until it stops. When CNC is reset during the execution the M, S, T instruction, the signal MF, SF, TF are set to 0 within 16ms.



2.5.2.1 External Reset Signal

ERS (G8.7)

●Signal type: PLC→NC

●Signal function: PLC sets G8.7 to 1 after receiving the external reset input signal, and transmit it to NC. When CNC resets, RST signal is changed to 1.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8	ERS							

2.5.2.2 Reset Signal

RST (F1.1)

●Signal type: NC→PLC

●Signal function: When CNC is in reset state, RST is set to 1. Then the signal is transmitted to PLC, PLC works according to the state of RST.

●Note: RST signal is set to 1 under the following conditions:

A: The external emergency stop input signal ESP is set to 0. B:

The external reset signal ERS is 1.

C: The “RESET” key on the panel is pressed.

In other conditions, the RST is set to 0 when the time set by data parameter No. 071 has passed.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1							RST	

2.5.2.3 Reset & Tread out Signal

RRW（G8.6）

●Signal type: PLC->NC

●Signal function: After the PLC receives the resetting & thread out signal, G8.6 replaces; the thread out of selected automatic operation program is performed when simultaneously resetting the CNC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G8		RRW						

RWD (F0.0)

●Signal type: NC->PLC

●Signal function: This signal informs the facts in the thread out treatment to the PLC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F0								RWD

2.5.2.4 External Workpiece Number Index

PN1,PN2,PN4,PN8,PN16（G0009.0～G0009.4）

●Signal type: NC->PLC

●Signal function: In the register operation mode, this signal is specified the performed workpiece number.

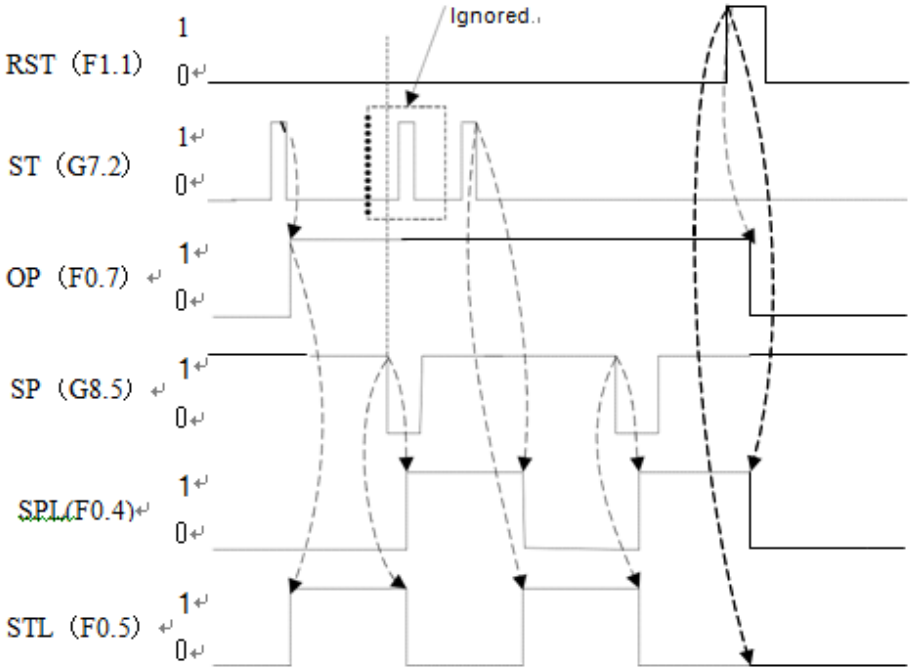
There are 5 codes signal, which are corresponded with the workpiec numbers, refer to the following table. (Binary system code)

Workpiece No. index signal					Workpiece No.
PN16	PN8	PN4	PN2	PN1	
0	0	0	0	0	00
0	0	0	0	1	01
0	0	0	1	0	02
Regardless of the centre					
1	1	1	1	0	30
1	1	1	1	1	31

In these signals, workpiece No.00 is used a special specification for “Without index”. Thus, the workpiece numbers can be specified the range among 01～31.

	#7	#6	#5	#4	#3	#2	#1	#0
G9				PN16	PN8	PN4	PN2	PN1

2.5.2.5 Operation Starting Sequence



2.5.2.6 Based on MDI Restting Confirmation Signal

MDIRST（F6.1）

●Signal type: NC->PLC

●Signal function: This signal informs that the “RESET” button is already controlled in MDI mode for the PLC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F6							MDIRST	

2.5.3 Machine Lock

The machine lock can be turned ON when the programs are being checked before machining. The MLK signal (all-axis machine lock signal) or MLK1~MLK4 signals (axis-by-axis machine lock signal) are set to 1. During manual or automatic operation, though the execution of inputting pulse to servo motor stops, CNC still assigns instructions; meanwhile the incremental and absolute coordinate systems are updated. The programs can be checked by monitoring the changing of coordinate system.

2.5.3.1 All-Axis Machine Lock Signal

MIK (G44.1)

●Signal type: PLC→NC

●Signal function: PLC sets MIK to 1 after receiving all-axis machine lock signal, and then transmits it to NC. All the axes cannot move.

●Note: When MIK is 1, during manual or automatic operation, CNC does not output pulse to servo motor and the worktable does not move.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G44							MIK	

2.5.3.2 All-Axis Machine Lock Check Signal

MMLK (F4.1)

●Signal type: NC→PLC

●Signal function: when all the axes are locked, CNC set all-axis machine lock check signal to 1 and then transmits it to PLC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4							MMLK	

2.5.4 Dry Run

Dry run is valid in automatic operation. The machine works at a constant feedrate rather than the specified feedrate in the program. This function is used to check the machine without workpiece. The dry run speed depends on the manual feed override signal (JV0~JV15).

Manual rapid traverse selection signal RT	Dry run speed
1	Manual rapid traverse speed
0	Manual feedrate

2.5.4.1 Dry Run Signal

DRN (G46.7):

●Signal type: PLC→NC

●Signal function: PLC sets DRN to 1 after receiving the dry run input signal, and then, transmits it to NC. CNC enters into dry run state.

●Note: A: When DRN is 1, the machine runs at the dry run speed; when it is 0, the machine works normally.

B: When DRN is changed from 0 to 1 or from 1 to 0 during the operation, the machine speed reduces to 0, and then increases to the specified feedrate.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G46	DRN							

2.5.4.2 Dry Run Check Signal

MDRN (F2.7):

●Signal type: NC→PLC

●Signal function: CNC sets MDRN to 1 in dry run state and then transmits it to PLC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2	MDRN							

2.5.5 Single Block

Single block execution is valid only during automatic operation, after the single block signal SBK is set to 1, and the current block is executed, the CNC enters into paused state. When the SBK is set to 0 again, the program starts running.

2.5.5.1 Single Block Signal

SBK (G46.1):

●Signal type: PLC→NC

●Signal function: PLC set SBK to 1 after receiving the single block input signal, and transmits it to NC. CNC enters into single block operation state.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G46							SBK	

2.5.5.2 Single Block Check Signal

MSBK (F4.3):

●Signal type: NC→PLC

●Signal function: CNC sets MSBK to 1 when it is in the single block execution state, and then transmits it to PLC.

●Note: A: During thread cutting, the SBK signal changes to 1. The operation stops after the first non-thread cutting block is executed.

B: During canned cycle, when the SBK signal is set to 1, the operation stops each time the tool approaches drilling holes or tool retracts (rather than stops at the end of the block).

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4					MSBK			

2.5.6 Optional Block Skip

During automatic operation, when a slash "/" is specified at the head of a block, and the optional block skip signal BDT is set to 1, the block is skipped during execution.

2.5.6.1 Optional Block Skip Signal

BDT (G44.0):

●Signal type: PLC→NC

●Signal function: PLC sets BDT to 1 after receiving the optional block skip input signal, and then transmits it to NC. CNC enters into the state of optional block skip. In a program, blocks started with "/" will not be executed.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G44								BDT

2.5.6.2 Optional Block Skip Check Signal

MBDT (F4.0):

●Signal type: NC→PLC

●Signal function: CNC sets MBDT to 1 during optional block skip execution, and then transmits it to PLC. PLC works according to the state of MBDT.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4								MBDT

2.5.7 Manual Absolute Function

When the machine works during manual operation (JOG feed or MPG feed), it determines whether the movement amount is added on the current workpiece coordinate value, and outputs a detection signal to indicates whether the manual absolute switch in CNC is ON or OFF.

2.5.7.1 Manual Absolute Signal

ABSM (G6.2)

●Signal type: PLC→NC

●Signal function: It sets the manual absolute signal to 1 or 0; when the signal is set to 1, the manual absolute function is invalid; when the signal is 0, the function is valid.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G6						ABSM		

2.5.7.2 Manual Absolute Check Signal

MABSM (F4.2)

●Signal type: NC→PLC

●Signal function: It informs PLC the state of manual absolute signal. When ABSM (G6.2) is 0, the signal is 1 and manual absolute function is valid; when ABSM (G6.2) is 1, this signal is 0, and the manual absolute function is invalid.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4						MABSM		

2.6 Feedrate Control

2.6.1 Rapid Traverse Signal

The rapid traverse speed of all axes can be set by parameter No.1420 rather than set when programming. It also can be adjusted by controlling the rapid traverse override.

RPD0 (F2.1):

●Signal type: NC→PLC

●Signal function: When CNC executes the movement command at the rapid traverse speed, it sets RPDO to 1 and then transmits it to PLC.

Note: A: When RPDO is 1, it means after rapid traverse is selected, an axis starts moving; when RPDO is 0, it means after non-rapid traverse speed is selected, an axis starts moving.

B: The rapid traverse in automatic operation includes canned cycle positioning, machine reference point return etc. The manual rapid traverse also includes machine reference point return.

C: Once the rapid traverse is selected, the signal is always 1 (even when the operation stops), till other feedrate is selected.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2							RPD0	

2.6.2 Rapid Traverse Override

An override of four steps (F0, 25%, 50%, 100%) can be applied to the rapid traverse rate. F0 is set by a parameter No. 1421.

In AUTO mode or MANUAL mode (including machine reference point return, program reference point return), the actual feedrate is the product of override value and the value set by data parameter No.1420.

Rapid Traverse Override Signal

ROV1, ROV2 (G14.0, G14.1)

●Signal type: PLC→NC

●Signal function: PLC assigns values to ROV1, ROV2 after receiving rapid traverse override input signal, and then transmits it to NC to determine the rapid traverse speed. The override values corresponding to ROV1, ROV2 are shown in the following table:

ROV2	ROV1	Override Value
0	0	100%
1	0	50%
0	1	25%
1	1	F0

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G14							ROV2	ROV1

2.6.3 Feedrate Override

A programmed feedrate can be reduced or increased by feedrate override signal. This feature is used to check a program. For example, when a feedrate of 100mm/min is specified in the program, setting the override to 50% can move the tool at a speed of 50mm/min.

Feedrate Override Signal

FV0 ~ FV7 (G12.0 ~ G12.7):

●Signal type: PLC→NC

●Signal function: PLC assigns values to FV0~FV7 after receiving the feedrate override input signal, and then transmits them to NC to determine the feedrate. The override values corresponding to FV0~FV7 is shown as follows:

FV7 ~ FV0 (G012.7 ~ G012.0)	Feedrate Override Value
0000 0000	0%
0000 0001	10%
0000 0010	20%
0000 0011	30%
0000 0100	40%
0000 0101	50%
0000 0110	60%
0000 0111	70%
0000 1000	80%
0000 1001	90%
0000 1010	100%
0000 1011	110%
0000 1100	120%
0000 1101	130%
0000 1110	140%
0000 1111	150%

●**Note:** During automatic running, actual feedrate is the product of the specified cutting feedrate and the feedrate override value.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G12	FV7	FV6	FV5	FV4	FV3	FV2	FV1	FV0

2.6.4 Override Cancel Signal

OVC (G6.4):

●Signal type: PLC→NC

●Signal function: PLC sets OVC to 1 after receiving the override cancel signal, and then transmits it to NC. The feedrate override is clamped at 100%.

●Note: When OVC is 1, the CNC performs as follows:

A: The feedrate is clamped at 100%, regardless of the feedrate override signal.

B: The rapid traverse override and spindle speed override are not affected by the signal.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G6				OVC				

2.7 MST Function

When the numbers followed address M, S, T are specified, the corresponding code signal and strobe signals are sent to PLC. PLC works according to the status of these signals. Shown as follows:

Function	Program address	NC–>PLC			(PLC->NC) End signal
		Code signal	Strobe signal	Distribution end signal	
Miscellaneous function	M	Mbit00 ~ Mbit31	MF	DEN	FIN
Spindle speed function	S	Sbit0 ~ Sbit31	SF		
Tool function	T	Tbit00 ~ Tbit31	TF		

The process is shown as follows: (changing M code to S, T codes is the process of spindle speed function and tool function.)

A: Assume that M XXX is specified in a program, an alarm is issued if CNC does not specify the number that followed.

B: After code signal Mbit00~Mbit31 are specified, the strobe signal MF is set to 1, and the command value XXX is expressed by code signal in binary system. When miscellaneous function is commanded along with other instructions, these functions are executed after the code signal of miscellaneous function is sent.

C: When the strobe signal is 1, PLC reads code signal and executes correspondingly.

D: In a block, when an execution is finished, another execution should be started after the distribution end signal DEN is changed to 1.

E: PLC sets the end signal FIN to 1 after the execution. The FIN signal is used in miscellaneous function, spindle speed function and tool function. If these functions are executed simultaneously, the FIN signal can be set to 1 only after all the execution are finished.

F: Only when the signal FIN is 1 (and should be 1 for a while), can CNC set the strobe signal to 0 and inform PLC the receival of end signal.

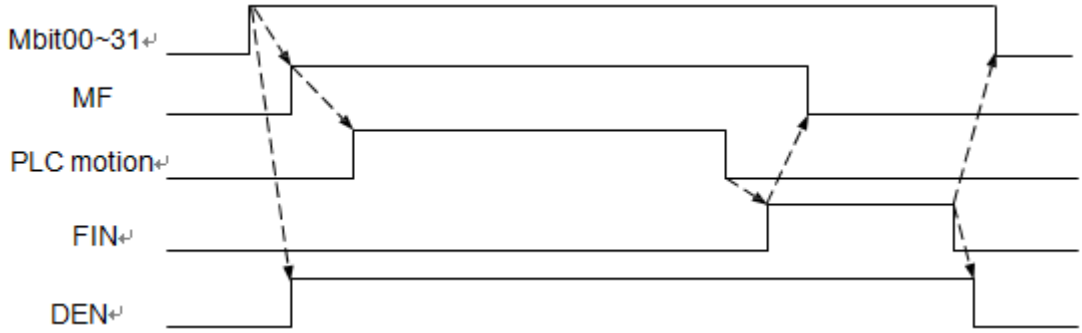
G: When the strobe signal is 0, PLC sets the FIN signal to 0.

H: When the FIN signal is 0, CNC sets all the code signals to 0 and ends all the execution of miscellaneous function.

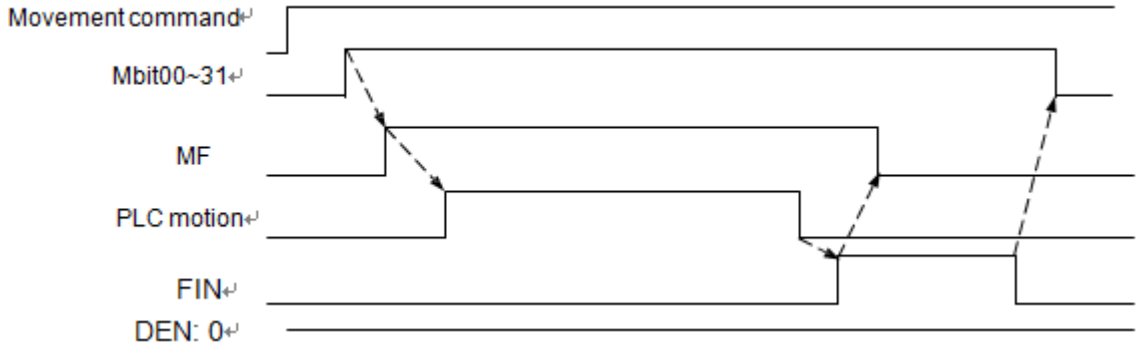
I: When the command execution is finished in a block, CNC preceeds execution to the next block.

The control sequence is shown as follows:

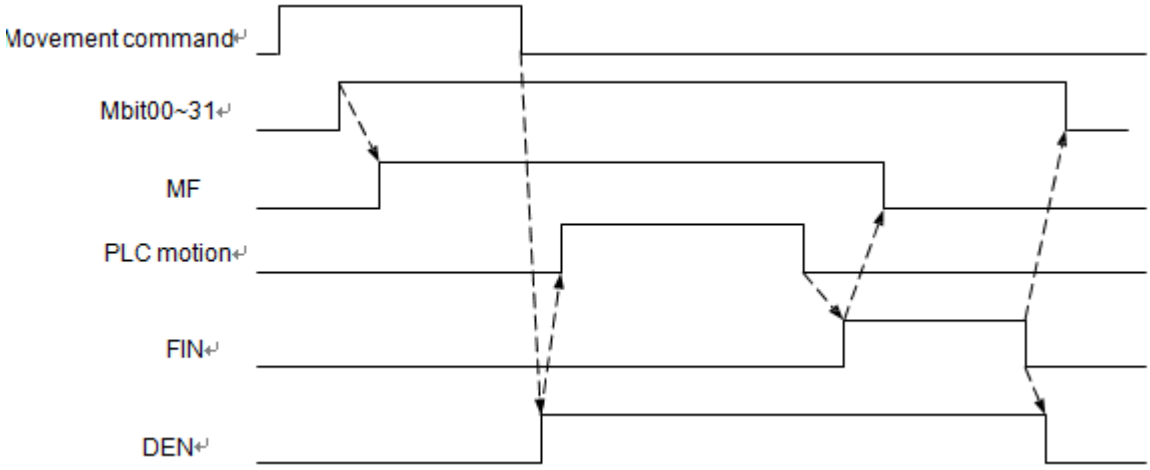
When a block contains a miscellaneous function:



When movement command and miscellaneous function are in the same block, the miscellaneous function is executed before the movement command execution is finished.



When movement command and miscellaneous function are in the same block, the miscellaneous function is executed after the movement command execution is finished.



2.7.1 Miscellaneous Function (M Function)

2.7.1.1 Code Signal and Strobe Signal

Code signal: Mbit00 ~ Mbit31 (F10~F13)

Strobe signal: MF (F7.0)

●Signal type: NC→PLC

●Signal function: After M code is executed, the corresponding F code signal is set to 1 and MF is set to 1, then these signals are transmitted to PLC. Please refer to the execution process instruction above for the output condition and execution process. The relationship between M command and code signal is shown as follows:

F13 ~ F10	M Command
F13, F12, F11, 00000000	M00
F13, F12, F11, 00000001	M01

F13, F12, F11, 00000010	M02
F13, F12, F11, 00000011	M03
F13, F12, F11, 00000100	M04
F13, F12, F11, 00000101	M05
F13, F12, F11, 00000110	M06
F13, F12, F11, 00000111	M07
F13, F12, F11, 00001000	M08
…	…

●**Note:** 1: The following miscellaneous function instructions cannot be output even when specified.

A: M98, M99, M198

B: M code for subprogram call

C: M code for custom macro program call

2: Of the miscellaneous function instructions that listed below, decoding signal can also be output in addition to code signal and strobe signal: M00, M01, M02, M30.

3: M00~M31 are in the form of binary code, for example, M5 corresponds to 00000000, 00000000, 00000000, 00000101, as listed above.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F10	**Mbit7**	**Mbit6**	**Mbit5**	**Mbit4**	**Mbit3**	**Mbit2**	**Mbit1**	**Mbit0**
F11	**Mbit15**	**Mbit14**	**Mbit13**	**Mbit12**	**Mbit11**	**Mbit10**	**Mbit8**	**Mbit8**
F12	**Mbit23**	**Mbit22**	**Mbit21**	**Mbit20**	**Mbit19**	**Mbit18**	**Mbit17**	**Mbit16**
F13	**Mbit31**	**Mbit30**	**Mbit29**	**Mbit28**	**Mbit27**	**Mbit26**	**Mbit25**	**Mbit24**
F7								**MF**

2.7.1.2 Decode M Signal

DM00 (F9.7), DM01 (F9.6), DM02 (F9.5), DM30 (F9.4):

●Signal type: NC→PLC, valid when it is 1.

●Signal function: When M00, M01, M02, M03 commands are executed, the corresponding decoding signal DM00, DM01, DM02, DM03 are set to 1.

Program command	Output signal
M00	DM00
M01	DM01
M02	DM02
M30	DM30

●Note: The M decoding signal is set to 1 under the following conditions:

The corresponding miscellaneous function is specified, and other movement command and program stop command have been executed in the same block. (When NC receives the FIN signal prior to the execution of movement command and program stop command, the M

decoding signal is not output.)

The M decoding signal is 0 under the following conditions:

FIN signal is 1 or CNC is reset.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F9	DM00	DM01	DM02	DM30				

2.7.1.3 Multiple M Commands in a Block

CNC allows up to 3 M codes in a block to be output to machine, which will shorten the machining time compared with traditional method (one M code in one block).

The 2nd M, 3rd M code signal: M2bit00 ~ M2 bit 15 (F14 ~ F15), M3 bit 00 ~ M3 bit 15 (F16 ~ F17)

The 2nd M, 3rd M strobe signal: MF2 (F8.4), MF3 (F8.5)

●Signal type: NC→PLC

●Signal function: After the 2nd, 3rd M codes are executed, the corresponding F code signal is set to 1 and MF2, MF3 are 1, then these signals are transmitted to PLC for logic control. The relationship between M command and code signals is shown in the following table:

F15 ~ F14	The 2nd M Command
F15, 00000000	M00
F15, 00000001	M01
F15, 00000010	M02
F15, 00000011	M03
F15, 00000100	M04
F15, 00000101	M05
F15, 00000110	M06
F15, 00000111	M07
F15, 00001000	M08
. .	. .

F17 ~ F16	The 3rd M Command
F17, 00000000	M00
F17, 00000001	M01
F17, 00000010	M02
F17, 00000011	M03
F17, 00000100	M04
F17, 00000101	M05
F17, 00000110	M06
F17, 00000111	M07
F17, 00001000	M08
. .	. .

●**Note:** 1. Some M codes cannot be specified due to operation limitation. Please refer to the manual from machine tool builder for the details operation limitations.

2. When M00, M01, M02 or M03 is specified along with other M codes, other M codes will not be executed; when M00, M01, M02 or M03 is specified together, the first M code is valid and other M codes will be ignored.

For example:

One M command in one block

```
M03    ;
M10    ;
M12 ;
G01 X100 Z100 ;
……
```

Multiple M commands in one block

```
M03 M10 M12 ;
G01 X100 Z100 ;
……
```

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F14	M2bit7	M2bit6	M2bit5	M2bit4	M2bit3	M2bit2	M2bit1	M2bit0
F15	M2bit15	M2bit14	M2bit13	M2bit12	M2bit11	M2bit10	M2bit8	M2bit8
F16	M3bit7	M3bit6	M3bit5	M3bit4	M3bit3	M3bit2	M3bit1	M3bit0
F17	M3bit15	M3bit14	M3bit13	M3bit12	M3bit11	M3bit10	M3bit8	M3bit8
F8			MF3	MF2				

2.7.2 Spindle Speed Function (S Function)

Spindle speed code signal S bit00~ S bit31 (F22~F25), Spindle speed strobe signal SF (F7.2)

●Signal type: NC→PLC

●Signal function: When S command is executed, NC sets the corresponding S code signal to 1, and SF is 1, then NC sends the signal to PLC for logic control. Please refer to the relevant instructions about to the output conditions and process. The relation between S command and binary code of code signal is shown as follows:

F25 ~ F22	S Command
F25, F24, F23, 00000000	S00
F25, F24, F23, 00000001	S01
F25, F24, F23, 00000010	S02
F25, F24, F23, 00000011	S03
F25, F24, F23, 00000100	S04
.	.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F22	Sbit07	Sbit06	Sbit05	Sbit04	Sbit03	Sbit02	Sbit01	Sbit00
F23	Sbit15	Sbit14	Sbit13	Sbit12	Sbit11	Sbit10	Sbit09	Sbit08
F24	Sbit23	Sbit22	Sbit21	Sbit20	Sbit19	Sbit18	Sbit17	Sbit16
F25	Sbit31	Sbit30	Sbit29	Sbit28	Sbit27	Sbit26	Sbit25	Sbit24
F7						SF		

2.7.3 Tool Function (T Function)

Tool function code signal

Tbit00 ~ Tbit31 (F26 ~ F29), tool function strobe signal TF (F7.3)

●Signal type: NC→PLC

●Signal function: When NC specifies T command, it sets the corresponding T code signal and TF to 1, and then transmits the signal to PLC for logic control. Please refer to the relevant information about to the output conditions and process. The relation between T command and binary code of T code signal is shown as follows:

F29 ~ F26	T Command
F29, F28, F27, 00000000	T00
F29, F28, F27, 00000001	T01
F29, F28, F27, 00000010	T02
F29, F28, F27, 00000011	T03
F29, F28, F27, 00000100	T04
.	. .

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F26	Tbit07	Tbit06	Tbit05	Tbit04	Tbit03	Tbit02	Tbit01	Tbit00
F27	Tbit15	Tbit14	Tbit13	Tbit12	Tbit11	Tbit10	Tbit09	Tbit08
F28	Tbit23	Tbit22	Tbit21	Tbit20	Tbit19	Tbit18	Tbit17	Tbit16
F29	Tbit31	Tbit30	Tbit29	Tbit28	Tbit27	Tbit26	Tbit25	Tbit24
F7					TF			

2.7.4 MST Function Completion

2.7.4.1 Completion Signal

FIN (G4.3)

●Signal type: PLC→NC

●Signal function: When the executions of miscellaneous function, spindle speed function and tool function are finished, PLC sets FIN to 1, and then transmits it to NC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G4					FIN			

MFIN (G5.0)

●Signal type: PLC→NC

●Signal function: When the execution of miscellaneous function is finished, PLC sets MFIN to 1, and then transmits it to NC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5								MFIN

SFIN (G5.2)

●Signal type: PLC→NC

●Signal function: When the execution of spindle speed function is finished, PLC sets SFIN to 1, and then transmits it to NC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5						SFIN		

TFIN (G5.3)

●Signal type: PLC→NC

●Signal function: When the execution of tool function is finished, PLC sets TFIN to 1, and then transmits it to NC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5					TFIN			

MFIN2 (G4.4), MFIN3 (G4.5)

●Signal type: PLC→NC

●Signal function: When the execution of M2, M3 is finished, PLC sets TFIN to 1, and then transmits it to NC.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G4			MFIN3	MFIN2				

DEN (F1.3)

●Signal type: NC→PLC

●Signal function: When miscellaneous function, spindle speed function, tool function are in the same block with other commands (such as movement command and dwell command), NC sets DEN to 1 after the execution of other commands, and waits for the FIN signal sent by PLC. After the block is executed, DEN is changed to 0.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1					DEN			

2.7.5 Miscellaneous Function Lock

2.7.5.1 Miscellaneous Function Lock Signal

AFL (G5.6):

●Signal type: PLC→NC

●Signal function: PLC sets AFL to 1 after receiving the miscellaneous function lock input signal, and then transmits it to NC to prevent the execution of M, S, T functions.

●Note: When the AFL signal is 1, CNC works as follows:

1. During automatic operation or operation in MDI mode, CNC does not execute the specified M, S, T functions, i.e. the code signal and strobe signal are not output.
2. If AFL is set to 1 after the code signal is output, CNC executes in normal sequence till the end (till it receives the FIN signal and sets the strobe signal to 0).
3. When AFL is 1, M01, M02, M03 commands can be executed, and the corresponding code signal, strobe signal, decoding signal are output in the normal way.
4. When AFL is 1, the miscellaneous function M98, M99 are executed normally, but the result is not output.
5. When AFL is 1, the spindle analog value can still be output.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G5		AFL						

2.7.5.2 Miscellaneous Function Lock Check Signal

MAFL (F4.4):

●Signal type: NC→PLC

●Signal function: When CNC is in the of miscellaneous function locked state, MAFL is set to 1, and then is transmitted to PLC.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F4				MAFL				

2.8 Spindle Speed Function

2.8.1 Spindle Speed Control

S command is used to specify the analog spindle speed controlled by CNC. For the constant surface speed (in G96 mode), CNC converts the specified surface speed to spindle speed. CNC can output the S command value and SF strobe command to PLC.

Spindle stop signal

SSTP (G29.6):

●Signal type: PLC→NC

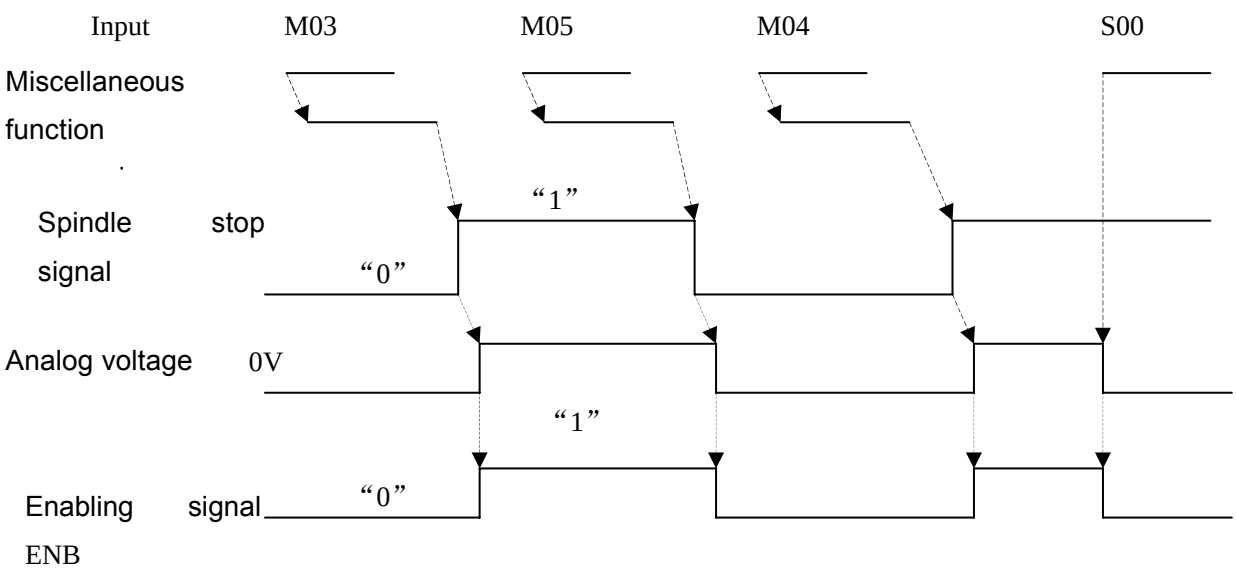
●Signal function: It stops the output of spindle speed command and sets the S command in NC to 0. The sequence is shown as follows:

●Note: When spindle stop signal *SSTP is 0, the output voltage is changed to 0V. When the signal is 1, the analog voltage output is the command value. When this signal is not used, it is set to 1 so that the CNC can execute spindle speed control.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G29		*SSTP						

S_ _ _ .



Spindle speed override signal

SOV00 ~ SOV07 (G30)

●Signal type: PLC→NC

●Signal function: After PLC receives the spindle speed override input signal, it assigns corresponding values to SOV00~SOV07, and then transmits them to NC to set different spindle speed overrides. The relationship between SOV00~SOV07 and the override values is shown as follows:

SOV7 ~ SOV0 (G30.7 ~ G30.0)	Override
0000 0101	50%

0000 0110	60%
0000 0111	70%
0000 1000	80%
0000 1001	90%
0000 1010	100%
0000 1011	110%
0000 1100	120%

●Note: The spindle override function is invalid during tapping cycle and thread cutting.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G30	SOV07	SOV06	SOV05	SOV04	SOV03	SOV02	SOV01	SOV00

Spindle enable signal

ENB (F1.4)

●Signal type: NC→PLC

●Signal function: It indicates whether the spindle command is sent from NC.

●Note: When a non-zero command is output to spindle, the ENB is1; when the command is 0, the ENB signal is changed to logic 0. In analog spindle, even the command output to spindle is 0 (i.e. the analog voltage is 0V), the spindle motor may work at low speed due to voltage drift of the inverter. In such case, the ENB signal can be used to stop the motor.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F1				ENB				

Gear selection signal

GR1, GR2 (G28.1, G28.2)

●Signal type: PLC→NC

●Signal function: It informs the CNC the current gear. Refer to the description above for details.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G28						GR2	GR1	

Constant surface speed signal

CSS (F2.2)

●Signal type: PLC→NC

●Signal function: When the signal is 1, it means the constant surface cutting speed control mode (G96) is executing; when it is 0, it means the mode is not executing.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2						CSS		

Spindle speed arrival signal SAR (G29.4)

●Signal type: PLC→NC

●Signal function: It informs the CNC that the spindle speed has reached the specified value.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G29				SAR				

Spindle motor speed selection command signal

SIND (G33.7)

●Signal type: PLC→NC

●Signal function: It is used to select the speed command of spindle motor.

SIND 1: selects the speed command transmitted from PLC.

0: selects the speed command transmitted from CNC, i.e. the spindle speed specified by S command.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G33	SIND							

The 1st spindle S12 digits code signal

R010~R120 (F36#0~F37#3)

●Signal type: CNC→PLC

●Signal function: It converts the spindle speed command calculated by CNC to code signals 0~0XFFF.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F36	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F37					R12O	R11O	R10O	R09O

The 1st spindle motor speed command input signal

R01I~R12I (G32#0~G33#3)

●Signal type: PLC→CNC

●Signal function: It indicates the input of spindle motor speed command sent from PLC.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G32	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
G33					R12I	R11I	R10I	R09I

The 1st spindle actual speed signal

AR00~AR15 (F40~F41)

●Signal type: CNC→PLC

●Signal function: It indicates the actual spindle speed transmitted from CNC to PLC. The spindle speed is detected by the position coder which is installed on the spindle and feedbacks the pulse indexing.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F40	AR07	AR06	AR05	AR04	AR03	AR02	AR01	AR00
F41	AR15	AR14	AR13	AR12	AR11	AR10	AR09	AR08

2.8.2 Multiple Spindles Control

Spindle selection signal

SWS1 (G27.0)
SWS2 (G27.1)

SWS3 (G27.2)

●Signal type: PLC→NC

●Signal function: It indicates whether the S command is output to spindle or not.

SWS1 1: Output to the 1st spindle
0: Do not output to the 1st spindle.

SWS2 1: Output to the 2nd spindle
0: Do not output to the 2nd spindle

SWS3 1: Output to the 3rd spindle
0: Do not output to the 3rd spindle

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G27						SWS3	SWS2	SWS1

The spindle selection signal for rigid tapping

RGTSP1（G61.4）

RGTSP2（G61.5）

RGTSP3（G61.6）

●Signal type: PLC->NC

●Signal function: **In multi-spindle,** the spindle selection signal is determined by parameter No.5200.7 whether to use this signal or SWS1\SWS2\SWS3.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G61		RGTSP3	RGTSP2	RGTSP1				

Spindles stop signal

SSTP1 (G27.3)

SSTP2 (G27.4)

SSTP3 (G27.5)

●Signal type: PLC→NC

●Signal function: It stops all the spindles. (Only valid for multiple spindles)

SSTP1 1: Do not output 0 rev./min. to the 1st spindle.

0: Output 0 rotation/min. to the 1st spindle.

SSTP2 1: Do not output 0 rev./min. to the 2nd spindle

0: Output 0 rotation/min. to the 2nd spindle.

SSTP3 1: Do not output 0 rev./min. to the 3rd spindle

0: Output 0 rotation/min. to the 3rd spindle.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G27			SSTP3	SSTP2	SSTP1			

Gear selection signal

GR11（G28.1～G28.2）

●Signal type：PLC->NC

●Signal function：The gear selection of the 1st spindle

Data parameters No.3741~No.3744 are set the 2nd spindle; its relationships between signal and gear are shown as follows:

GR1_2	GR1_1	gear	Parameter No. for the max. speed of the 1st spindle
0	0	1	data parameters No.3741
0	1	2	data parameters No.3742
1	0	3	data parameters No.3743
1	1	4	data parameters No.3744

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G28						GR1_2	GR1_1	

GR21（G29.0～G29.1）

●Signal type: PLC→NC

●Signal function: It selects the gear of the 2nd spindle when the multiple spindles are installed.

Data parameter No.3741~No.3744 sets the 2nd spindle.The relationship between signal and gear is shown as follows:

GR2_2	GR2_1	gear	Parameter No. for the max. speed of the 2nd spindle
0	0	1	data parameters No.3741
0	1	2	data parameters No.3742
1	0	30	data parameters No.3743
1	1	4	data parameters No.3744

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G29							GR2_2	GR2_1

GR31（G29.2～G29.3）

●Signal type：PLC->NC

●Signal function：It selects the gear of the 3rd spindle when the multiple spindles are installed.

Data parameter No.3741~No.3744 sets the 3rd spindle.The relationship between signal and gear is shown as follows:

GR3_2	GR3_1	gear	Parameter No. for the max. speed of the 3rd spindle
0	0	1	data parameters No.3741
0	1	2	data parameters No.3742
1	0	3	data parameters No.3743
1	1	4	data parameters No.3744

●Signal address：

	#7	#6	#5	#4	#3	#2	#1	#0
G29					GR3_2	GR3_1		

The 2nd position encoder selection signal

PC2SLC (G28.7)

●Signal type: PLC→NC

●Signal function: It selects the position coder.

PC2SLC 1: Selects the feedback pulse obtained from the 2nd spindle encoder.

0: Selects the feedback pulse obtained from the 1st spindle encoder.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G28	PC2SLC							

The 2nd spindle enable signal

ENB2 (F38.2)

●Signal type: NC→PLC

●Signal function: It informs the PLC whether the command signal is output to the 2nd spindle. It is used as the condition of stopping the analog spindle.

ENB2 1: Enables the 2nd spindle speed control

0: Does not enable the 2nd spindle speed control

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F38						ENB2		

The 2nd spindle motor speed selection command signal

SIND2 (G35.7)

●Signal type: PLC→CNC

●Signal function: It selects the speed command of the 2nd spindle motor.

SIND2 1: selects the speed command from PLC.

0: selects the speed command from CNC, i.e. the spindle speed specified by S command.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G35	SIND2							

The 2nd spindle S12 digits code signal

R01O2~R12O2 (F200#0~F201#3)

●Signal type: CNC→PLC

●Signal function: It converts the spindle speed calculated by CNC to the code signals 0~0XFFF.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F200	R08O2	R07O2	R06O2	R05O2	R04O2	R03O2	R02O2	R01O2
F201					R12O2	R11O2	R10O2	R09O2

The 2nd spindle motor speed command input signal

R01I2~R12I2 (G34#0~G35#3)

●Signal type: PLC→CNC

●Signal function: It indicates the input of the 2nd spindle motor speed command from PLC.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G34	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
G35					R12I2	R11I2	R10I2	R09I2

The 2nd spindle actual speed signal

AR002~AR152 (F202~F203)

●Signal type: PLC→CNC

●Signal function: It indicates the actual spindle speed transmitted from CNC to PLC. The spindle speed is detected by the position encoder which installed on the spindle and feedbacks the pulse indexing.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F202	AR072	AR062	AR052	AR042	AR032	AR022	AR012	AR002
F203	AR152	AR142	AR132	AR122	AR112	AR102	AR092	AR082

Each spindle rotation direction of the multi-spindle control

The 1st spindle reverse signal SRVA (G70.4)

The 1st spindle positive signal SFRA (g70.5)

The 2nd spindle reverse signal SRVB (g74.4)

The 2nd spindle positive signal SFRB (G74.5)

The 3rd spindle reverse signal SRVC (G78.4)

The 3rd spindle reverse signal SFRC (g78.5)

●Signal type: CNC->PLC

●Signal function: Inform the operation direction of current each spindle at the side of NC

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G70			SFRA	SRVA				
G74			SFRB	SRVB				
G78			SFRC	SRVC				

2.8.3 Spindle Position/Speed Switch

Spindle contour control switching signal

CON (G27.7)

●Signal type: PLC→NC

●Signal function: It specifies the Cs contour control function. The control mode can be spindle speed control or Cs contour control. When the signal is 1, the control mode is switched to Cs contour control mode; when the signal is 0, spindle speed control mode is switched back.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G27	CON							

Spindle contour control switching completion signal

FSCSL (F44.1)

●Signal type: NC→PLC

●Signal function: When this signal is 0, it indicates the controlled axis is in spindle speed control mode. When the signal is 1, it indicates the controlled axis is in the Cs contour control mode.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F44							FSCSL	

Rigid tapping signal RGTAP（G61.0）

●Signal type: PLC->NC

●Signal function: PLC sets to rigid tapping method by M29 (Rigid tapping method preparation miscellaneous function).

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G61								RGTAP

Spindle outline control shifting signal in the multi-spindle control

The 1st spindle outline control shifting signal CONS1 (G254.0)

The 2nd spindle outline control shiting signal CONS2 (G254.1)

The 3rd spindle outline control shiting signal CONS3 (G254.2)

●Signal type: PLC->NC

●Signal function: The used spindle outline control shifting signal in the multi-spindle control.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G254						CONS3	CONS2	CONS1

2.9 Tool Function

When T code or HDT signal is specified, NC compares the desired tool numbers with the current tool numbers NOWT00~NOWT07, if the numbers are consistent, tool change will not be executed; if not, the code signal and strobe signal of the desired tool number are generated, and the machine selects tools accordingly.

In this CNC system, the tool change can be performed by T command in AUTO or MDI mode, or the sequence tool change be performed through HDT signal in MANUAL mode.

Tool change by T command

Tool change can be performed through T command in AUTO or MDI modes. CNC sends the tool number signal and tool strobe signal after it decodes the T command, and then waits for the completion of PLC tool change.

The current tool number signal

NOWT00 ~ NOWT07

G201

●Signal type: PLC→NC

●Signal function: When PLC detects the current tool position, it sets corresponding values to NOWT00 ~ NOWT07 (G201), and then informs NC the current tool number. These tool numbers are expressed in binary system.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G201	NOWT07	NOWT06	NOWT05	NOWT04	NOWT03	NOWT02	NOWT01	NOWT00

2.10 Other Functions

2.10.1 Metric/Inch Conversion

Inch input signal INCH (F2.0)

●Signal type: NC→PLC

●Signal function: When INCH=1, inch input mode (G20) is adopt; INCH=0, metric input mode (G21) is adopted.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2								INCH

2.10.2 Thread Cutting

Thread cutting signal THRD (F2.3)

●Signal type: NC→PLC

●Signal function: It indicates that the thread cutting is in-processing.

This signal is 1 in the following conditions:

1. In thread cutting mode.
2. Thread cutting is in-processing.

This signal is 0 when neither condition 1 nor 2 is fulfilled.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F2					THRD			

2.10.3 Parts Count

Target parts count reached signal PRTSF (62.7)

●Signal type: NC→PLC

●Signal function: Signal PRTSF is output to PLC when the number of machined parts reaches the target. The number of parts is regarded as infinity when the number of required parts is zero. The PRTSF signal is then not output.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F62	PRTSF							

2.10.4 Directly Input Function B by Cutter Compensation Measurement Value

Signal GOQSM (G39.7) selection of cutter compensation value write-in method

●Signal type: PLC->NC

●Signal function: Select the write-in method of tool compensation value

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G39	GOQSM							

Tool compensation selection signal OFN0～OFN5（G39.0～G39.5）

●Signal type: PLC->NC

●Signal function: tool compensation number selection

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G39			OFN5	OFN4	OFN3	OFN2	OFN1	OFN0

2.10.5 Directly Input Function of Tool Compensation Measurement Value

Position record signal PRC（G40.6）

●Signal type: PLC->NC

●Signal function: The used signal when the tool compensation measurement value is directly input. When the signal becomes “1”, capture the uprising edge of this signal, store the current position of the overall axes at this moment.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G40		PRC						

2.11 PLC Axis Control Function

2.11.1 General

PLC can be independent from the CNC to control the specified axis, in another word, it enables a tool to move on a axis which is not controlled by CNC, for example, to specify a move distance and feedrate. Besides, tool post, exchange worktable, indexing worktable and other peripheral devices are controllable.

The maximum controlled axis number is 6. Parameters No. 1010 and No. 8010 set the controlled axis number for CNC and PLC respectively. Whether an axis is controlled by CNC or PLC is determined by axis control signal EAX. The following operation can be done by PLC directly:

(1). Rapidly traverse the specified distance;

(2). Cutting feed (per min.), move the specified distance;

(3). Cutting feed (per rotation), move the specified distance;

(4). Dwell;

(5). Continuous feed

(6). Manual reference point return;

(7). The 1st reference point return;

(8). The 2nd reference point return;

(9). The 3rd reference point return;

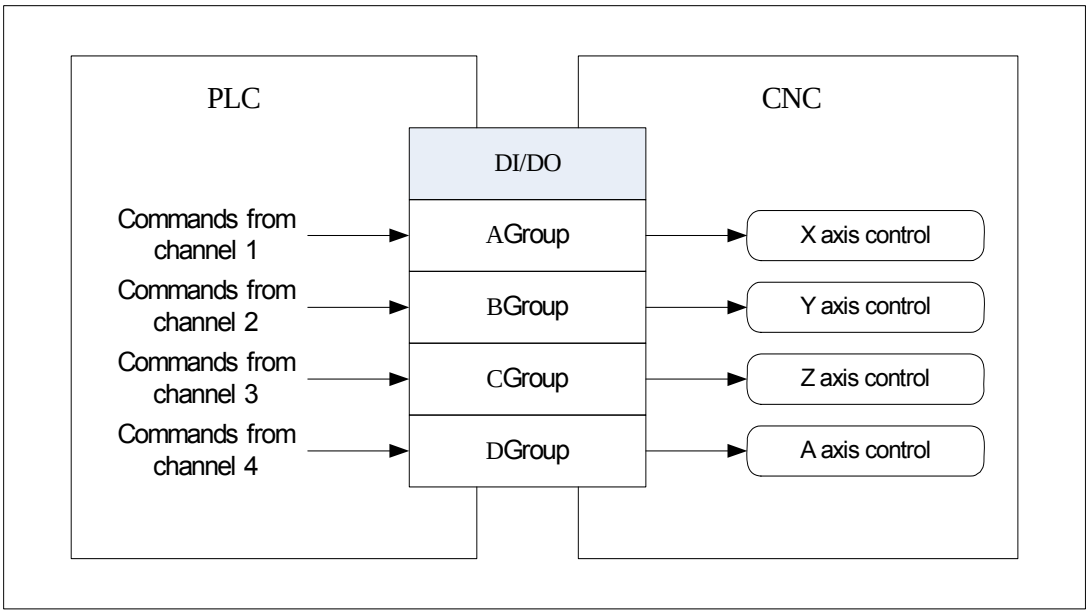
(10). The 4th reference point return;

(11). Feedrate control;

(12). Miscellaneous function, the 2nd miscellaneous function, the 3rd miscellaneous function;

(13) Machine coordinate system selection;

PLC provides 4 control channels for the signal input and output. PLC can control 5 independent axes by issuing instructions via the 4 channels. Parameter No. 8010 determines the corresponding axes of channels. One channel can corresponds to 2 or more axes, which enables the PLC to control multiple axes via one channel. The control diagram is shown as follows:



In the following text, the input/output signal from 4 channel are group A (channel 1), group B (channel 2) group C (channel 3), group D (channel 4) respectively. The names of input/output signals of PLC controlled axis contain a lower-case letter “g”.

2.11.2 Basic Procedures

The basic procedures of PLC axis control are shown as follows:

(1). Parameter No. 8010 determines the axis to be controlled by DI/DO signal group (A, B, C or D). When one group is used to control 2 or more axes, the parameter setting values related to feedrate (rapid traverse rate, acceleration/deceleration time constant, diameter/radius, linear axis/rotary axis) of each axis should be identical.

(2). Set the selection signal (EAX1~EAX5) of controlled axis to 1 for direct PLC control.

(3). Determine the operation type

Axis control command signal (EC0g to EC6g) instructs the operation type. Axis control feedrate signal (EIF0g to EIF15g) instructs the feedrate. Axis control data signal (EID0g to EID31g) instructs the move distance and other data.

These signals, together with the block stop disabled signal EMSBKg, determine a complete

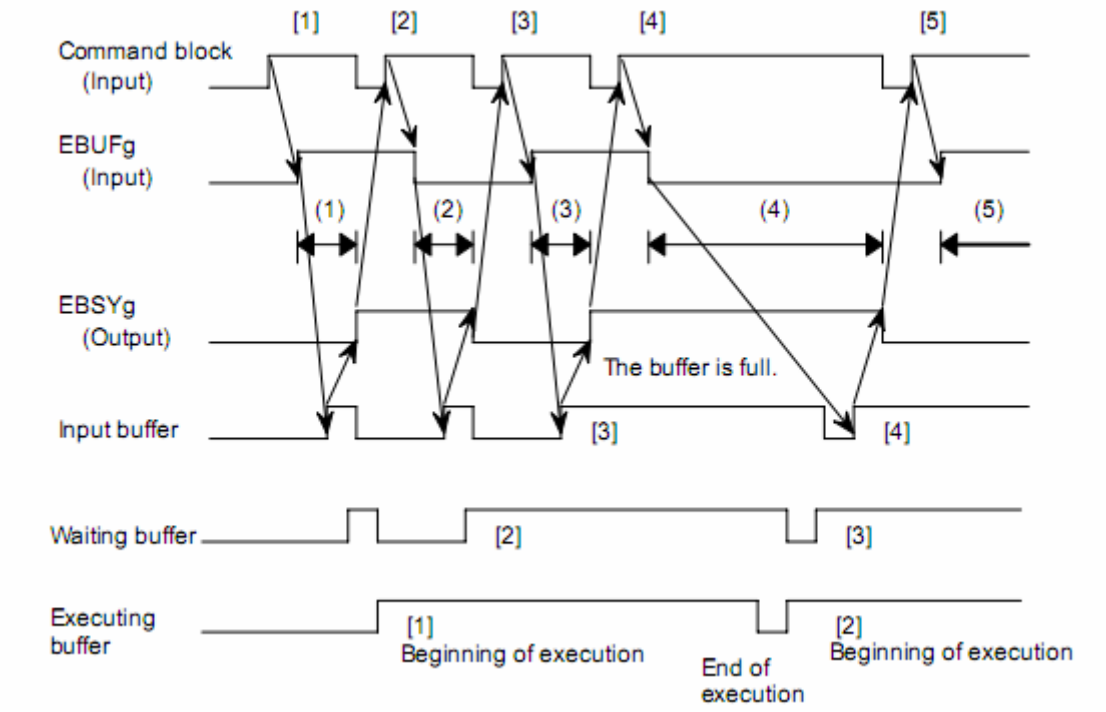
operation, equaling to the execution of a block during CNC automatic operation. These signals are called axis control block data signal.

The PLC controlled axis signal table:

General	Signal Name	Symbol	Data Type
Axis control block data signal	Block stop disabled signal	EMSBKg	Bit
	Axis control command signal	EC0g~EC6g	Byte
	Axis control feedrate signal	EIF0g~EIF15g	Word
	Axis control data signal	EID0g~EID31g	Double-word

(4). When a data for managing a complete operation (a block) is certain, the inverse axis controls the logic status of command read signal EBUFg (i.e. from 0 to 1, or the opposite). Therefore, the logic status of axis control command read complete signal (EBSYg) should be the same as that of EBUFg.

CNC stores the axis control function in the buffer; therefore, multiple PLC axis control operations are allowable in sequence. If the buffer is vacant, CNC can receive a new block command from PLC when another block is executing. There are 3 kinds of buffers: input, waiting and executing. The following figure shows the operation sequence.



Use the XOR of the axis controllable command read signal EBUFg input from PLC and the axis controllable command read completion signal EBSYg output from CNC to determine the state of CNC buffer area.

EBUFg	EBSYg	XOR	CNC Buffer Status
0	0	0	The previous block has already been read into CNC buffer; the next block can be issued.
1	1		

0	1	1	The previous block is not read yet; PLC is waiting for the vacancy of CNC buffer and does not issue the next block, nor invert the logic status of EBUFg. The inversion of EBUFg status will disable the issued block.
1	0		

(5). Repeat the procedures 3 and 4 till all the blocks are issued.

When the last block is issued, set the axis control selection signal EAX1 to EAX5 to 0. However, before setting the signals to 0, make sure that the blocks in input, waiting and executing buffer are completely executed. Otherwise, P/S alarm will be issued. This alarm will stop the execution and disable the blocks in input and wait buffer.

To ensure that there is not block is being executed or input, and there is no reserved block in wait buffer, the control axis selection status signal *EAXSL should be set to 0.

For the axes which are always controlled by PLC, for example, the axes that control tool post, exchange worktable and ATC, make sure that EAX1 to EAX 5 are always 1. After a command is issued from PLC to CNC, these signals are not necessarily set to 0. When all the blocks are executed (except for those not necessary), CNC automatically stops.

(6). When the axis selection signals EAX1 ~ EAX5 are from 1 to 0, the CNC holds the control.

2.11.3 Signal Details

2.11.3.1 Control Axis Selection Signal

EAX1 ~ EAX5 (G136.0 ~ G136.4)

●Signal type: PLC→NC

●Signal function: When the signal is set to 1, the corresponding axis is controlled by PLC.

When the signal is set to 0, PLC control is disabled. Only when the control axis selection status signal *EAXSL is set to 0, can the control axis selection signal be changed. When *EAXSL is 1, and the control axis selection signal is changed, a P/S alarm (No. 139) will be generated. Alarm signal EIALg is set to 1. Commands from CNC are executed when the following conditions are fulfilled: the bit 5 of parameter No. 8001 (NCC) is set to 0; the control axis selection signal is set to 1, and the *EAXSL signal is set to 0. However, when the bit 5 of parameter No. 8001 (NCC) is set to 1, the execution of other two conditions will lead to a P/S alarm. Note that in manual continuous feed mode, when the tool is moving along an axis, this command is invalid.

If the control axis selection signal is set to 1 when the CNC is executing a command, a P/S alarm (No. 139) will be generated. In manual continuous feed mode, setting this signal to 1 will enable the suspension of the execution. When the control axis selection signal is set to 1, a P/S alarm (No. 139) is generated, at the same time, *EAXSL is set to 0, and alarm signal EIALg is not changed to 1, in this case, even the CNC is in alarm state, the axis can still be controlled by PLC.

●**Note:** The time from setting the control axis selection signals EAX1~EAX5 to 1 to PLC forwarding instructions to CNC should be 8ms at least.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G136				EAX5	EAX4	EAX3	EAX2	EAX1

2.11.3.2 Axis Control Command Signal

EC0g ~ EC6g (G141.0~6),(G151.0~6), (G161.0~6), (G171.0~6)

●Signal type: PLC→NC

●Signal function: Perform the following operations via each channel.

Axis control command (hexadecimal code)	Operation
00h	Rapid traverse (linear acceleration/deceleration)
	Execute the same G00 as CNC.
01h	Cutting feed per minute (exponential acceleration/ deceleration after interpolation)
	Execute the same G98, G01 as CNC.
02h	Cutting feed per rotation (exponential acceleration/ deceleration after interpolation)
	Execute the same G99, G01 as CNC.
04h	Dwell
	Execute the same G04 as CNC.
05h	Reference point return
	Set the direction of reference point return direction according to bit 5 of parameter No. 1006, and moves the tool in rapid traverse mode, then, execute manual reference point return which is usually performed by CNC.
06h	Continuous feed (exponential acceleration/deceleration)
	Move the tool along the specified direction in JOG mode then, execute JOG feed which is usually performed by CNC.
07h	The 1st reference point return
	Move the tool to the reference point via the middle point, just like the G28 specified by CNC.
08h	The 2nd reference point return
	Position the tool to the reference point via the middle point, just like the G30P2 specified by CNC.
09h	The 3rd reference point return
	Position the tool to the reference point via the middle point, just like the G30P3 specified by CNC.
0Ah	The 4th reference point return
	Position the tool to the reference point via the middle point, just like the G30P4 specified by CNC.
	Speed command (linear acceleration/deceleration)

10h	Continuous feed with the specified speed
12h	Miscellaneous function
	Execute the same miscellaneous function as CNC.
14h	The 2nd miscellaneous function.
	Execute the same miscellaneous function as CNC.
15h	The 3rd miscellaneous function.
	Execute the same miscellaneous function as CNC.
20h	Machine coordinate system selection
	Execute the same G53 function as CNC.

Rapid traverse rate

When the rapid traverse (EC0g ~ EC6g:00h) is used, the feedrate can be same one as specified by CNC (No. 1420) or can be specified by PLC axis feedrate signals EIF0g to EIF15g. It can be set by the bit 0 of parameter No. 8002.

Reference point return without dog

The following operation can be realized by reference point return command (EC0g to EC6g): the bit 1 of parameter No. 1002 sets that the reference point return without dog is performed on all the controlled axis; the bit 1 of parameter No. 1005 (DLZx) sets that the reference point return without dog is performed only on one axis. When one of the above condition is set, and reference point return has not performed yet, the tool will move along the direction set by the bit 5（ZMIx）of parameter No.1006 after the reference point return command (EC0g to EC6g:05h) is issued. Deceleration signal is not involved (the tool moves to the grid point adjacent to the current position).

After the reference point is set, reference point return is performed at a high speed after the command (EC0g to EC6g:05h) is issued, regardless of the reference point return direction set by bit 5 (ZMIx) of parameter No. 1006.

The 1st reference point return without dog

If the 1st reference point return command (EC0g to EC6g:07h) is issued when no reference point return has ever been performed after power-on, and the bit 1 of parameter No. 1002 and bit 1 of No. 1005 are valid, a P/S alarm (No. 090) will be generated.

The 1st to 4th reference point return

When returning to the commands (from EC0g to EC6g: from 07h to 0Ah) by using the reference positions from the 1st to the 4th, the feedrate can be set by the bit 0 (RPD) of parameter No. 8002 with the same method as it is set in rapid traverse command (EC0g to EC6g:00h).

Note that the in the condition of the 1st reference point return, if no manual reference point return has performed after power-on,the feedrate is specified by parameter No. 1424.

Speed command

When speed command (EC0g to EC6g:10h) is used, the axis specified by bit 0 of parameter No. 1006 (ROTx) is the rotary axis. When position control is being performed by continuous feed

command (EC0g to EC6g:06h), the speed of servo motor is controlled by speed command (EC0g to EC6g). In this way, during the continuous feed, the speed dynamic variation is allowable, which enables the command applicable for servo motor to drive the tools.
Parameter No. 8028 can set the linear acceleration/deceleration time constant for each axis. Note that when the JOG feed is performed with speed command, the coordinate value does not change, which will result in the loss of tool position. Therefore, reference point return should be performed before movement command and after continuous feed.

Machine coordinate system selection

Machine coordinate system selection (EC0g to EC6g:20h) adopts absolute positioning and rapid traverse. It is used to move the tool to a specified position, such as tool exchange position.
For the rotary axis, short-path rotation command can be used when tool offset and tool nose radius compensation is cancelled.

Machine coordinate system should be set before the command is used. Move the tool to the reference point manually or via G28 after power-on. When absolute position detector is used, reference point return is not necessary, because the tool position is stored in the memory.

The following table shows the relationship between axis control command and data:

Command block		
Operation	**Axis Control**	**Command Data**
Rapid traverse	00h	The total move distance: EID0g to EID31g Rapid traverse rate: EIF0g to EIF15g The rapid traverse is valid when the bit 0（RPD）of parameter No. 8002 is 1.
Feed per minute	01h	The total move distance: EID0g to EID31g Feedrate: EIF0g to EIF15g
Feed per rotation	02h	The total move distance: EID0g to EID31g Feed amount per rotation: EIF0g to EIF15g
Dwell	0	Dwell time: EID0g to EID31g
Reference point return	05	None
JOG feed	06	Feed direction: EID31g JOG feedrate: EIF0g to EIF15g
The 1st reference point return	07	Rapid traverse rate: EIF0g to EIF15g When the bit 0 of parameter No.8002 (RPD) is set to 1, the rapid traverse rate is valid.
The 2nd reference point return	08	

The 3rd reference point return	09	
The 4th reference point return	0A	
Speed command	10	Continuous feedrate: EIF0g to EIF15g
Miscellaneous function	12	Miscellaneous function code: EID0g to EID15g
The 2nd miscellaneous function	14h	
The 3rd miscellaneous function	15h	
Machine coordinate system setting	20h	Machine coordinate system setting (absolute value): EID0g to EIG31g Rapid traverse rate EIF0g to EIF15g When the bit 0 (RPD) of parameter No.8002 is set to 1, the rapid traverse rate is valid.

●Signal addresses:

G141
G151
G161
G171

#7	#6	#5	#4	#3	#2	#1	#0
	EC6A	EC5A	EC4A	EC3A	EC2A	EC1A	EC0A
	EC6B	EC5B	EC4B	EC3B	EC2B	EC1B	EC0B
	EC6C	EC5C	EC4C	EC3C	EC2C	EC1C	EC0C
	EC6D	EC5D	EC4D	EC3D	EC2D	EC1D	EC0D

2.11.3.3 Axis Control Feedrate Signal

EIF0g ~ EIF15g(G142,G143), (G152,G153), (G162,G163), (G172,G173)

●Signal type: PLC→NC

●Signal function: Specify the feedrate of PLC controlled axis

Rapid traverse (EC0g to EC6g:00h)

The 1st reference point return (EC0g to EC6g: 07h) The 2nd reference point return (EC0g to EC6g: 08h) The 3rd reference point return (EC6g: 09h)

The 4th reference point return (EC0g to EC6g: 0Ah)

When the bit 0 of parameter No. 8002 (RPD) is set to 1, the signal instructs rapid traverse rate in binary form. However, for the 1st reference point return, parameter No. 1424 determines the rapid traverse rate if no reference point return has been performed after power-on.

The unit is shown in the following figure.

		Increment System		Unit
		IS-B	IS-C	
Linear axis	Metric machine	1		mm/min
	Inch machine	0.1		inch/min
Rotary axis		1		deg/min

The valid data range is show in the following figure.

		Increment System		Unit
		IS-B	IS-C	
Linear axis	Metric machine	30~15000	30~12000	mm/min
	Inch machine	30~6000	30~4800	inch/min
Rotary axis		30~15000	30~12000	deg/min

Cutting feed per minute (EC0g to EC6g:01h)

The signal instructs a feedrate in binary form. When the bit 3 of parameter No. 8002 (F10) is set to 1, the federate is multiplied by 10.

The data is shown as follows:

When the bit 3 of parameter No. 8002 (F10) is 0:

		Increment System		Unit
		IS-B	IS-C	
Linear axis	Metric machine	1	0.1	mm/min
	Inch machine	0.01	0.001	inch/min
Rotary axis		1	0.1	deg/min

When the bit 3 of parameter No. 8002 (F10) is 1:

		Increment System		Unit
		IS-B	IS-C	
Linear axis	Metric machine	10	1	mm/min
	Inch	0.1	0.01	inch/min
Rotary axis		10	1	deg/min

The valid data range is shown as follows:

	Increment System		Unit
	IS-B	IS-C	

Linear axis	Metric machine	1~100000	0.1~12000.0	mm/min
	Inch machine	0.01~4000.00	0.001~480.000	inch/min
Rotary axis		1~100000	0.1~12000.0	deg/min

Cutting feed per rotation (EC0g to EC6g: 02h)

This signal is used to specify the tool movement amount per spindle rotation.

The incremental unit is depend on the bit 6 (FR1) and bit 7 (FR2) of parameter No. 8002. Shown as follows:

Parameter		Metric Input (mm/rev)	Inch input (inch/rev)	Rotary axis (deg/rev)
FR2	FR1			
1	1	0.0001	0.000001	0.0001
0	0			
0	1	0.001	0.00001	0.001
1	0	0.01	0.0001	0.01

The valid data range is shown as follows:

		Increment System		Unit
		IS-B	IS-C	
Linear axis	Metric machine	0.0001~500.0000		mm/rev
	Inch machine	0.000001~9.999999		inch/rev
Rotary axis		0.0001~500.0000		deg/rev

Continuous feed (EC0g to EC6g: 06h)

Set the feedrate (EC0g to EC6g: 01h) just like the cutting feed (per minute). During the continuous feed, the feedrate can be changed by signals EIF0g to EIF15g. After the axis control command read signal EBUFg is reversed, the tool moves at a new feedrate.

The EBUFg signal is usually not checked because the JOG feed command is not buffered.

The specified feedrate can be the 10 times of the data set by bit 3 of parameter No. 8002 and the 200 times of the data set by bit 2 (JFM) of parameter No. 8004.

Speed command (EC0g to EC6g: 10h)

The signal instructs the servo motor speed in binary system.

Positive command means positive direction of rotation, while negative command means the negative direction of rotation.

When a new servo motor speed is commanded, the logic of axis control command read signal EBUFg is inverted, which will increase or reduce the servo motor speed.

●**Note:** When the command is set to 0, the CNC sequentially executes the buffer rather than move the tool. In this case, the input reset signal ECLRg can be used to release the buffer. Cutting speed limitation is invalid.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G142	EIF7A	EIF6A	EIF5A	EIF4A	EIF3A	EIF2A	EIF1A	EIF0A
G143	EIF15A	EIF14A	EIF13A	EIF12A	EIF11A	EIF10A	EIF9A	EIF8A

	#7	#6	#5	#4	#3	#2	#1	#0
G152	EIF7B	EIF6B	EIF5B	EIF4B	EIF3B	EIF2B	EIF1B	EIF0B
G153	EIF15B	EIF14B	EIF13B	EIF12B	EIF11B	EIF10B	EIF9B	EIF8B

	#7	#6	#5	#4	#3	#2	#1	#0
G162	EIF7C	EIF6C	EIF5C	EIF4C	EIF3C	EIF2C	EIF1C	EIF0C
G163	EIF15C	EIF14C	EIF13C	EIF12C	EIF11C	EIF10C	EIF9C	EIF8C

	#7	#6	#5	#4	#3	#2	#1	#0
G172	EIF7D	EIF6D	EIF5D	EIF4D	EIF3D	EIF2D	EIF1D	EIF0D
G173	EIF15D	EIF14D	EIF13D	EIF12D	EIF11D	EIF10D	EIF9D	EIF8D

2.11.3.4 Axis Control Data Signal

EID0g ~ EID31g

(G144,G145,G146,G147), (G154,G155,G156,G157)
(G164,G165,G166,G167), (G174,G175,G176,G177)

●Signal type: PLC→NC

●Signal function: Specifies the PLC axis control data

The data unit is shown as follows:

		Increment System		Unit
		IS-B	IS-C	
Linear axis	Metric input	0.001	0.0001	mm
	Inch input	0.0001	0.00001	inch
Rotary axis		0.001	0.00001	deg

Rapid traverse (EC0g to EC6g: 00h)

Cutting feed per minute (EC0g to EC6g: 01h)

Cutting feed per rotation (EC0g to EC6g:02h)

The signal EID0g to EID 31g is used according the input increment. The incremental move distance is specified in binary system.

The valid data range is shown in the following table:

		Increment System		Unit
		IS-B	IS-C	
Linear axis	Metric input	±99999.999	±9999.9999	mm
	Inch input	±9999.9999	±999.99999	inch
Rotary axis		±99999.999	±9999.9999	deg

When setting the diameter programming by the 3rd bit (DIAx) of the parameter №1006, the bit 1 of

parameter No. 8005 (CDI) determines whether radius or diameter is used in command.

Dwell (EC0g to EC6g: 04h)

The signal instructs the dwell time in binary system.

Data Range	Unit
1~99999999	ms

Continuous feed (EC0g to EC6g: 06h)

Signal EID31g is used to instruct the direction of continuous feed as follows:

0: Positive direction

1: Negative direction

The signals EID0g to EID30 are undefined.

Miscellaneous function (EC0g to EC6g:12h)

The 2nd miscellaneous function (EC0g to EC6g:14h)

The 3rd miscellaneous function (EC0g to EC6g:15h)

Signals instruct the transmission of miscellaneous function code from CNC to PLC. According to the setting of bit 6 of parameter No. 8001 (AUX), 1 or 2 bytes of signal EID0g to EID15g can be used.

Machine coordinate system selection (EC0g to EC6g:20h)

The signal instructs the absolute coordinate system in binary system according to the increment system.

●Note: When increment system IS-C is used, the least input increment of dwell time is 0.1ms according to the bit 1 of parameter No. 8002 (DWE).

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G144	EID7A	EID6A	EID5A	EID4A	EID3A	EID2A	EID1A	EID0A
G145	EID15A	EID14A	EID13A	EID12A	EID11A	EID10A	EID9A	EID8A
G146	EID23A	EID22A	EID21A	EID20A	EID19A	EID18A	EID17A	EID16A
G147	EID31A	EID30A	EID29A	EID28A	EID27A	EID26A	EID25A	EID24A

	#7	#6	#5	#4	#3	#2	#1	#0
G154	EID7B	EID6B	EID5B	EID4B	EID3B	EID2B	EID1B	EID0B
G155	EID15B	EID14B	EID13B	EID12B	EID11B	EID10B	EID9B	EID8B
G156	EID23B	EID22B	EID21B	EID20B	EID19B	EID18B	EID17B	EID16B
G157	EID31B	EID30B	EID29B	EID28B	EID27B	EID26B	EID25B	EID24B

	#7	#6	#5	#4	#3	#2	#1	#0
G164	EID7C	EID6C	EID5C	EID4C	EID3C	EID2C	EID1C	EID0C
G165	EID15C	EID14C	EID13C	EID12C	EID11C	EID10C	EID9C	EID8C
G166	EID23C	EID22C	EID21C	EID20C	EID19C	EID18C	EID17C	EID16C

G167	EID31C	EID30C	EID29C	EID28C	EID27C	EID26C	EID25C	EID24C

	#7	#6	#5	#4	#3	#2	#1	#0
G174	EID7D	EID6D	EID5D	EID4D	EID3D	EID2D	EID1D	EID0D
G175	EID15D	EID14D	EID13D	EID12D	EID11D	EID10D	EID9D	EID8D
G176	EID23D	EID22D	EID21D	EID20D	EID19D	EID18D	EID17D	EID16D
G177	EID31D	EID30D	EID29D	EID28D	EID27D	EID26D	EID25D	EID24D

2.11.3.5 Axis control Command Read Signal

EBUFg (G140.7), (G150.7), (G160.7), (G170.7)

●Signal type: PLC→NC

●Signal function: It instructs the CNC to read the command data block used for PLC control. When the signal is turn from 0 to 1 or from 1 to 0, the detailed running procedures is described in “Basic Procedures”.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G140	EBUFA							
G150	EBUFB							
G160	EBUFC							
G170	EBUFD							

2.11.3.6 Axis Control Command Read Completed Signal

EBSYg (F140.7), (F150.7), (F160.7), (F170.7)

●Signal type: NC→PLC

●Signal function: It informs the system that CNC has read one command data block and stored in the buffer. Refer to section “Basic Procedures” for the details of output condition and procedures.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140	EBSYA							
F150	EBSYB							
F160	EBSYC							
F170	EBSYD							

2.11.3.7 Reset Signal

ECLRg (G140.6), (G150.6), (G160.6), (G170.6)

●Signal type: PLC→NC

●Signal function: To reset the corresponding PLC controlled axis.

When this signal is 1, the following operation is to be executed: (1). When the tool is moving along axis: tool decelerates till stops. (2). When the tool is in dwell state: operation is stopped.
(3). When miscellaneous function is being executed, stop the operation.

Meanwhile, all the buffer commands are cleared. When the signal is 1, any control command is ignored.

When all these commands are forced to stop, the servo motor decelerates till stops, the axis motion signal EGENg is set to 0 and the control axis selection status signal *EAXSL turns to 0. Do NOT set ECLRg to 0 until the *EAXSL turns to 0.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G140		ECLRA						
G150		ECLRB						
G160		ECLRC						
G170		ECLRD						

2.11.3.8 Axis Control Pause Signal

ESTPg (G140.5), (G150.5), (G160.5), (G170.5)

●Signal type: PLC→NC

●Signal function: When this signal is set to 1, the following procedures are executed:

(1) When tool is moving along an axis: tool decelerates till stops.
(2) When the tool is in dwell state: the operation stops.
(3) When the miscellaneous function is being executed: when miscellaneous function completed signal EFINg is input, the operation stops. The operation can be re-started when the signal is set to 0.

●Signal addresses:

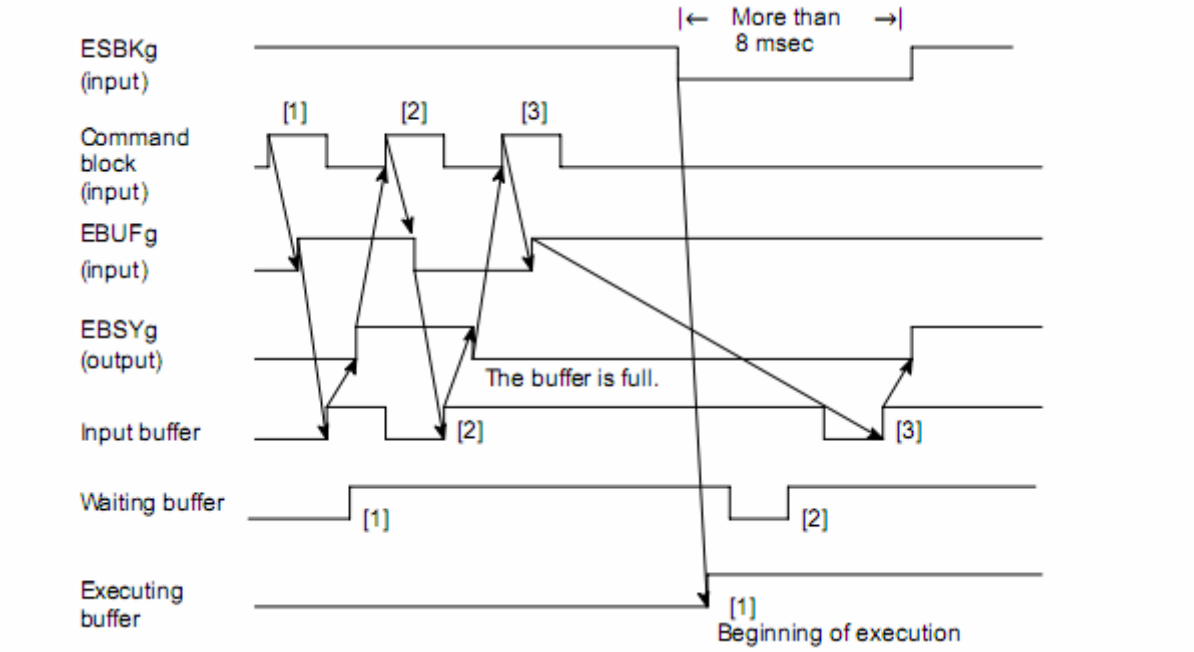
	#7	#6	#5	#4	#3	#2	#1	#0
G140			ESTPA					
G150			ESTPB					
G160			ESTPC					
G170			ESTPD					

2.11.3.9 Block Stop Signal

ESBKg (G140.3), (G150.3), (G160.3), (G170.3)

●Signal type: PLC→NC

●Signal function: When the instructions issued by PLC are being executed, and the block stop signal ESBKg is set to 1, the axis control stops after a block execution is accomplished. When the signal is set to 0, the instructions in buffer are executed. The sequence diagram is shown as follows:



●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G140					**ESBKA**			
G150					**ESBKB**			
G160					**ESBKC**			
G170					**ESBKD**			

2.11.3.10 Block Stop Disabled Signal

EMSBKg (G141.7), (G151.7), (G161.7), (G171.7)

●Signal type: PLC→NC

●Signal function: When the block stop disabled signal EMSBKg is set to 1 in the current block, the signal ESBKg is invalid.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G141	EMSBKA							

G151	EMSBKB							
G161	EMSBKC							
G171	EMSBKD							

2.11.3.11 Miscellaneous Function Code Signal

EM11g ~ EM48g(F142, F143), (F152, F153), (F162, F163), (F172, F173)

●Signal type: NC→PLC

●Signal function: When miscellaneous function (EC0g to EC6g: 12h), the 2nd miscellaneous function command (EC0g to EC6g:14h) and the 3rd miscellaneous function command (EC0g to EC6g:15h) are issued from PLC, the miscellaneous function code is issued in 1 byte (EID0g toEID7g) or 2 bytes (EID0g to EID15g), which depends on the bit 6 of parameter No. 8001 (AUX).

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F142	EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A
F143	EM48A	EM44A	EM42A	EM41A	EM38A	EM34A	EM32A	EM31A

	#7	#6	#5	#4	#3	#2	#1	#0
F152	EM28B	EM24B	EM22B	EM21B	EM18B	EM14B	EM12B	EM11B
F153	EM48B	EM44B	EM42B	EM41B	EM38B	EM34B	EM32B	EM31B

	#7	#6	#5	#4	#3	#2	#1	#0
F162	EM28C	EM24C	EM22C	EM21C	EM18C	EM14C	EM12C	EM11C
F163	EM48C	EM44C	EM42C	EM41C	EM38C	EM34C	EM32C	EM31C

	#7	#6	#5	#4	#3	#2	#1	#0
F172	EM28D	EM24D	EM22D	EM21D	EM18D	EM14D	EM12D	EM11D
F173	EM48D	EM44D	EM42D	EM41D	EM38D	EM34D	EM32D	EM31D

2.11.3.12 Strobe Signal of Miscellaneous Function

EMFg (F141.0), (F151.0), (F161.0), (F171.0)

●Signal type: NC→PLC

●Signal function: When the code instructions of miscellaneous function are sent, this signal is set to 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F141								EMFA
F151								EMFB

F161								EMFC
F171								EMFD

2.11.3.13 The 2nd Miscellaneous Function Strobe Signal

EMF2g (F141.2), (F151.2), (F161.2), (F171.2)

●Signal type: NC→PLC

●Signal function: When the code instructions of miscellaneous function are sent, this signal is set to 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F141						EMF2A		
F151						EMF2B		
F161						EMF2C		
F171						EMF2D		

2.11.3.14 The 3rd Miscellaneous Function Strobe Signal

EMF3g (F141.3), (F151.3), (F161.3), (F171.3)

●Signal type: NC→PLC

●Signal function: When the code instructions of miscellaneous function are sent, this signal is set to 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F141					EMF3A			
F151					EMF3B			
F161					EMF3C			
F171					EMF3D			

2.11.3.15 Miscellaneous Function Completion Signal

EFINg (G140.0), (G150.0), (G160.0), (G170.0)

●Signal type: PLC→NC

●Signal function: CNC sends the miscellaneous function code to miscellaneous function code signal (EM11g~EM28g and EM31g to EM48g) and waits for the miscellaneous function completed signal EFINg. When EFINg returns, CNC proceeds to the next block.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G140								EFINA
G150								EFINB

G160								EFINC
G170								EFIND

2.11.3.16 Buffering Inhibited Signal

EMBUFg (G140.2), (G150.2), (G160.2), (G170.2)

●Signal type: PLC→NC

●Signal function: When this signal is 1, and a block is being executed, waited or input in a buffer, instructions from the PLC are not read. When all the buffers are vacant, instruction are read by sequence.

To identify the status of buffer, CNC only outputs axis control command read completion signal EBSYg when there is vacancy in buffer on CNC.

For the following instructions, the buffer is inhibited regardless the status of buffering inhibited signal EMBUFg.

(1). Reference point return (EC0g to EC6g:05h)

(2). The 1st reference point return (EC0g to EC6g:07h) (3).

The 2nd reference point return (EC0g to EC6g: 08h) (4).

The 3rd reference point return (EC0g to EC6g:09h) (5). The

4th reference point return (EC0g to EC6g: 0Ah)

(6). Machine coordinate system selection (EC0g to EC6g:20h)

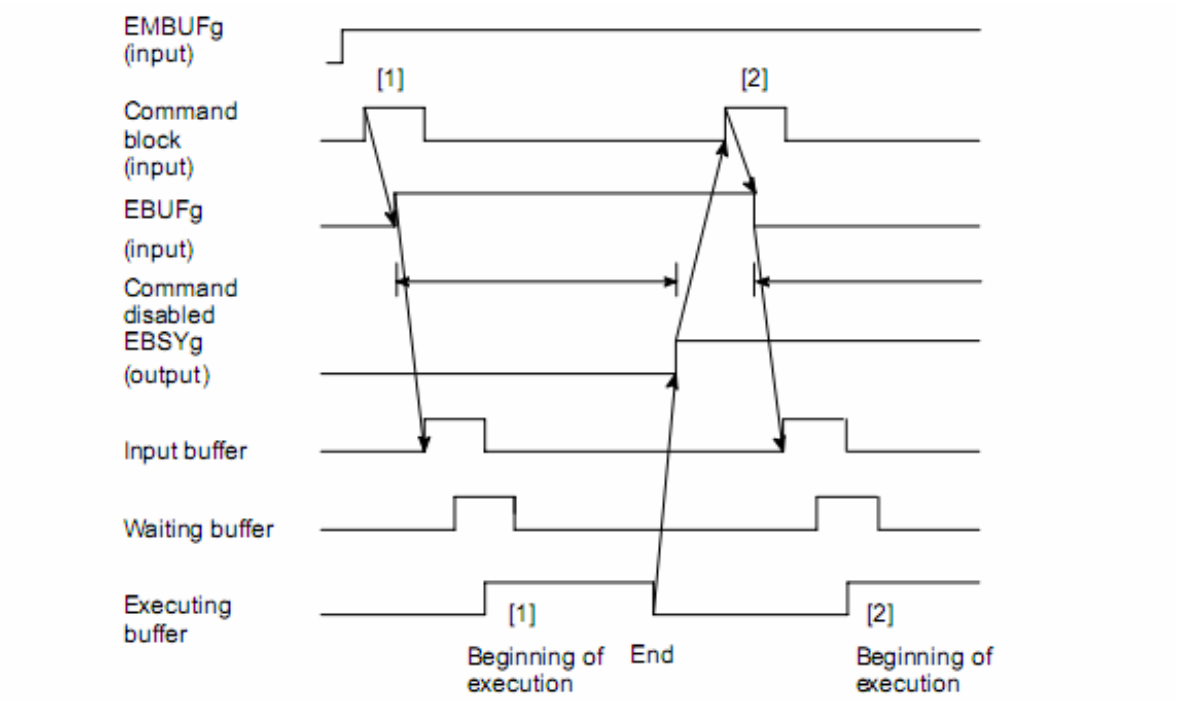
The following instructions are ended by reset signal ECLRg. They are executed when the buffering operation is inhibited, i.e. the subsequent blocks are cancelled rather than executed.

For the following instructions, the reset signal ECLRg is used for ending. They are executed when the inhibiting buffer is disabled, i.e. the blocks that followed are cancelled instead of executed.

(1).Continuous feed (EC0g to EC6g:06h)

(2).Continuous instructions (EC0g to EC6g:10h)

The operation sequence diagram is as follows:



●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G140						EMBUFA		
G150						EMBUFB		
G160						EMBUFC		
G170						EMBUFD		

2.11.3.17 Control Axis Selection Status Signal

***EAXSL (F129.7)**

●Signal type: NC→PLC

●Signal function: When the signal is set to 0, control axis selection signal EAX1 to EAX5 are changeable.

This signal is 1 in the following conditions:

(1). When tool moves along the PLC controlled axis. (2).

When a block is being read into buffer.

When this signal is 1, the control axis selection signal EAX1 to EAX5 cannot be changed. Any attempt to change these signals will lead to P/S alarm No. 139.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F129	*EAXSL							

2.11.3.18 In-Position Signal

EINPg (F140.0), (F150.0), (F160.0), (F170.0)

●Signal type: NC→PLC

●Signal function: When the corresponding PLC controlled axis is in in-position status, this signal is set to 1.

When the tool decelerates, in-position check is performed, and the next command is executed till the tool moves into the in-position area. However, in-position check can be skipped by the bit 6 of parameter No. 8004 (NCI) to reduce the cycle time.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140								EINPA
F150								EINPB
F160								EINPC
F170								EINPD

2.11.3.19 Following Error Zero Checking Signal

ECKZg (F140.1), (F150.1), (F160.1), (F170.1)

●Signal type: NC→PLC

●Signal function: When following error zero check or in-position check is performed on PLC controlled axis, this signal is 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140							ECKZA	
F150							ECKZB	
F160							ECKZC	
F170							ECKZD	

2.11.3.20 Alarm Signal

EIALg (F140.2), (F150.2), (F160.2), (F170.2)

●Signal type: NC→PLC

●Signal function: When a servo alarm, overtravel alarm or P/S alarm (No. 130 and No. 139) occurs, this signal is 1. After the alarm is removed and the reset signal ECLRg is 1, this signal is 0.

Servo alarm

Remove the alarm, and then reset CNC.

Overtravel alarm

Move the tool to the stored limit area, and then reset CNC.

The following instruction can be used to move the tool into the stored limit area: (1). Rapid traverse (EC0g to EC6g:00h)

(2). Cutting feed per minute (EC0g to EC6g:01h) (3). Cutting feed per rotation (EC0g to EC6g: 02h) (4). Continuously feed (EC0g to EC6g:06h)

P/S alarm

Reset CNC.

In the above conditions, not the reset signal ECLRg but the RESET button on the panel can reset CNC.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140						EIALA		
F150						EIALB		
F160						EIALC		
F170						EIALD		

2.11.3.21 Axis Movement Signal

EGENg (F140.4), (F150.4), (F160.4), (F170.4)

●Signal type: NC→PLC

●Signal function: When tool moves on the PLC controlled axes according to such instructions as rapid traverse and cutting feed, this signal is 1.

●Note: When axes assignment is finished, this signal is set to 0. During deceleration, this signal is set to 0.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140				EGENA				
F150				EGENB				
F160				EGENC				
F170				EGEND				

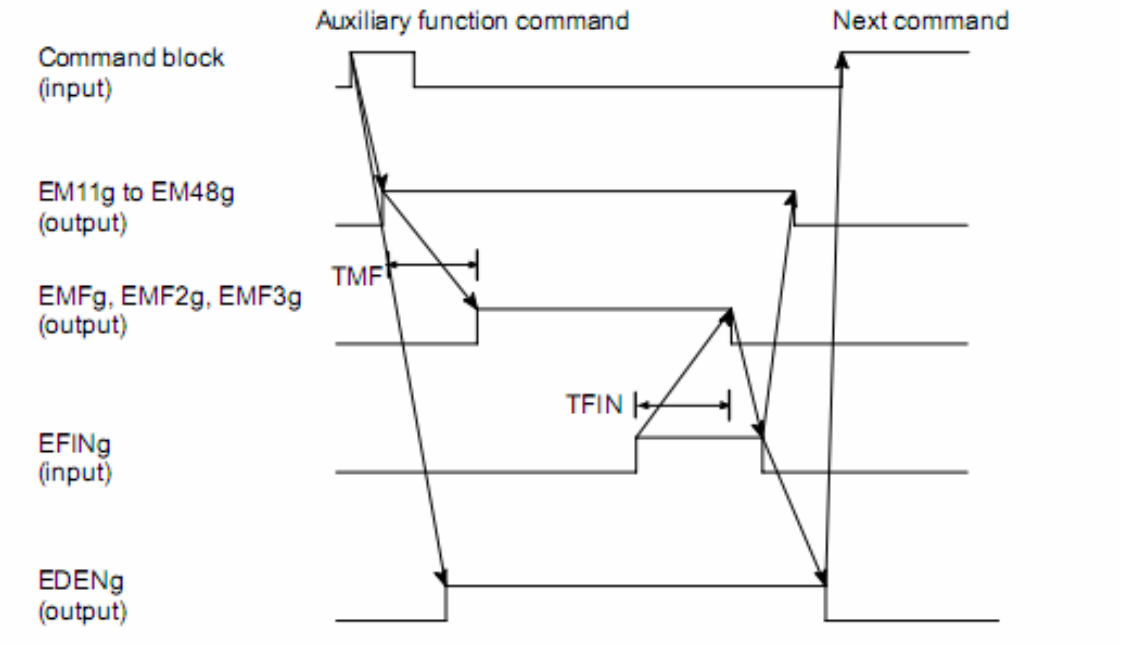
2.11.3.22 Miscellaneous Function Execution Signal

EDENg (F140.3), (F150.3), (F160.3), (F170.3)

●Signal type: NC→PLC

●Signal function: When the miscellaneous function is instructed by PLC, miscellaneous function code EID0g to EID15g are sent to miscellaneous function code signal EM11g to EM48g. This signal is 1 till the miscellaneous function completion signal EFINg returns.

The operation sequence diagram is shown as follows:



●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140					EDENA			
F150					EDENB			
F160					EDENC			
F170					EDEND			

2.11.3.23 "–" Direction Overtravel Signal

EOTNg (F140.6), (F150.6), (F160.6), (F170.6)

●Signal type: NC→PLC

●Signal function: When the movement exceeds the "–" direction limit, signal EOTNg is 1, meanwhile, the alarm signal EIALg is 1. When the overtravel alarm is removed and reset

signal ECLRg is 1, signals EOTNg and EIALg signal are 0.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140		EOTNA						
F150		EOTNB						
F160		EOTNC						
F170		EOTND						

2.11.3.24 "+" Direction Overtravel Signal

EOTPg (F140.5), (F150.5), (F160.5), (F170.5)

●Signal type: NC→PLC

●Signal function: When the movement exceeds the "+" direction limit, signal EOTPg is 1, meanwhile, the alarm signal EIALg is 1. When the overtravel alarm is removed and reset signal ECLRg is 1, signals EOTPg and EIALg signal are 0.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F140			EOTPA					
F150			EOTPB					
F160			EOTPC					
F170			EOTPD					

2.11.3.25 Feedrate Override Signal

***FV0E ~ *FV3E (G138)**

●Signal type: PLC→NC

●Signal function: These signals are used to select the cutting feedrate override, just like CNC feedrate override signals *FV0 to *FV7. Set that the override of PLC controlled axis is not related to CNC through the bit 2 of parameter No. 8001 (OVE). The calculation method is the same as CNC. When all the signals are set to 0, the override is taken as 0%.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G138	*FV7E	*FV6E	*FV5E	*FV4E	*FV3E	*FV2E	*FV1E	*FV0E

2.11.3.26 Override Cancel Signal

OVCE(G137.5)

●Signal type: PLC→NC

●Signal function: When the bit 2 of parameter No. 8001 (OVE) is 1, the override of PLC is not related to CNC. When this signal is set to 1, the cutting feedrate override is always 100%. The rapid traverse override will not be affected by this signal.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G137			OVCE					

2.11.3.27 Rapid Traverse Override Signal

ROV1E, ROV2E(G137.0, G137.1)

●Signal type: PLC→NC

●Signal function: These signals are used to set the override of rapid traverse. The bit 2 of parameter No. 8001 (OVE) sets that the rapid traverse override of PLC is not related to CNC.

Rapid Traverse Override Signal		Override
ROV2E	ROV1E	
0	0	100%
0	1	50%
1	0	25%
1	1	F0

F0 is the low speed set by parameter No. 1421.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
G137							ROV2E	ROV1E

2.11.3.28 Dry Run Signal

DRNE (G137.7)

●Signal type: PLC→NC

●Signal function: The bit 2 of parameter No. 8001 is used to instruct the dry run. When the dry run signal DRNE is set to 1, the specified rapid traverse rate and cutting feedrate are ignored. Tool moves at the speed when the dry run speed multiplies a specified override. Bit 3 of parameter No. 8001 (RDE) determines the validness of dry run for rapid traverse.

Manual Rapid Traverse Selection Signal	Instructions from PLC	
	Rapid traverse	Cutting feed
1	Rapid traverse rate	Maximum cutting feedrate
0	Dry run feedrate ×FV or rapid traverse rate	Dry run feedrate ×FV

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G137	DRNE							

2.11.3.29 Manual Rapid Traverse Selection Signal

RTE (G137.6)

●Signal type: PLC→NC

●Signal function: During dry run, when the manual rapid traverse selection signal RTE is set to 1, the tool moves at the rapid traverse rate, and the maximum cutting feedrate. When the signal is 0, the tool moves at the dry-run speed. When the dry run signal DRNE is 0, the specified rapid traverse rate or cutting feedrate is adopted again.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
G137		RTE						

2.11.3.30 Override 0% Signal

EOV0 (F129.5)

●Signal type: NC→PLC

●Signal function: When the feedrate override is 0%, this signal is 1.

●Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F129			EOV0					

2.11.3.31 Distribution Completion Signal

EADEN1 ~ EADEN5(F112.0 ~ F112.4)

●Signal type: NC→PLC

●Signal function: When tool is moving according to PLC instructions, these signals are set to 0. When tool stops (except for the occasion that signal ESPg stops the axis movement), these signals are set to 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F112				EADEN5	EADEN4	EADEN3	EADEN2	EADEN1

2.11.3.32 Buffer Full Signal

EABUFg (F141.1), (F151.1), (F161.1), (F171.1)

●Signal type: NC→PLC

●Signal function: When the input buffer contains a block, this signal is 1.

●Signal addresses:

2.11.3.33 Control Signal

EACNT1 ~ EACNT5 (F192.0 ~ F192.4)

●Signal type: NC→PLC

●Signal function: When the control axis selection status signal *EAXSL is set to 1, the signals EACNTn of the controlled axis is set to 1.

●Signal addresses:

	#7	#6	#5	#4	#3	#2	#1	#0
F192				EACNT5	EACNT4	EACNT3	EACNT2	EACNT1

CHAPTER 3 PROGRAMMING

3.1 Sequential Program Structuring

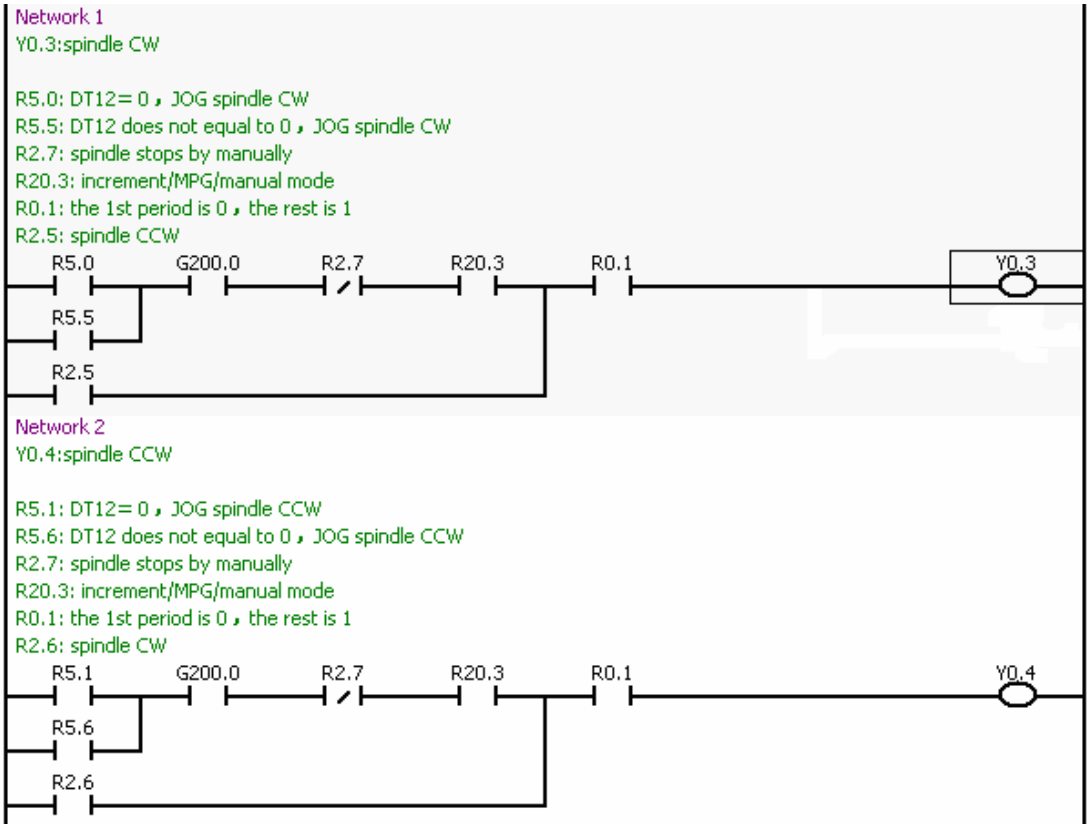
Sequential program is a program for logic control to machine tool and relevant devices. Programs are executed by the sequence in PLC. In traditional PLC, programs are written in sequence. However, the GSK988TA/988TA1/988TB PLC integrates the traditional PLC and modern programming method by using structured programming with which methods such as sub-program, subprogram nesting and conditional branch can be applied. It has distinct advantages compared with traditional PLC.

3.2 Execution Procedures

A written program (Ladder) can be downloaded via serial ports or U disk. CNC will read it after power-on, and then convert it into a recognizable format so that the CPU can decode and calculate it.

The PLC sequence control is realized through software, therefore, the working principles is different from the general relay circuit. The working principles of PLC sequence control should be taken into consideration during designing.

In general relay circuit, all relays can work synchronically. The following figure shows that when condition is fulfilled, Y0.3 and Y0.4 can be output; In PLC sequence control, all outputs are executed in sequence. When R0.1 is closed, and R2.5 and R2.6 are closed, Y0.3 is output in advance; then, Y0.4 is output in shortest delay time. The executions are followed by sequence.



3.2.1 Program Loop

PLC program is executed from the beginning to the end, and is re-executed from the beginning when it ends. This process is called program loop.

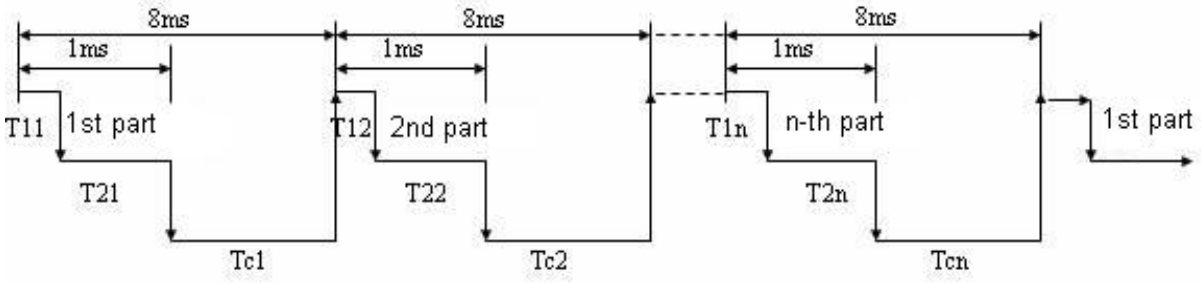
The time from beginning to the end is called loop processing cycle. Shorter processing cycle enables stronger signal response capacity.

3.2.2 Priority of Execution

A sequence program consists of two parts: 1st level sequence and 2nd level sequence. The 1st level sequence part is less than 600 steps and operates every 8ms to process the quickly responded short pulse signal; the 2nd level sequence part operates every 8n (ms). Here n is a dividing number for the 2nd level sequence part. The 2nd level sequence part is divided automatically according to the required execution time. The cycle of execution is 8ms

The 2nd level sequence part must be divided in order to execute the 1st level sequence part. When the dividing number is n, the execution process is shown in the following figure. T11, T12, T1n are the required time for the execution of the 1st level sequence part every 8ms for the n-th loop; T21, T22 and T2n are the required time for the execution of the 1st, 2nd, n-th division part of the 2nd sequence part for the 1st loop. Tc1, Tc2, and Tcn are the occupied time every 8ms in the 1st loop.

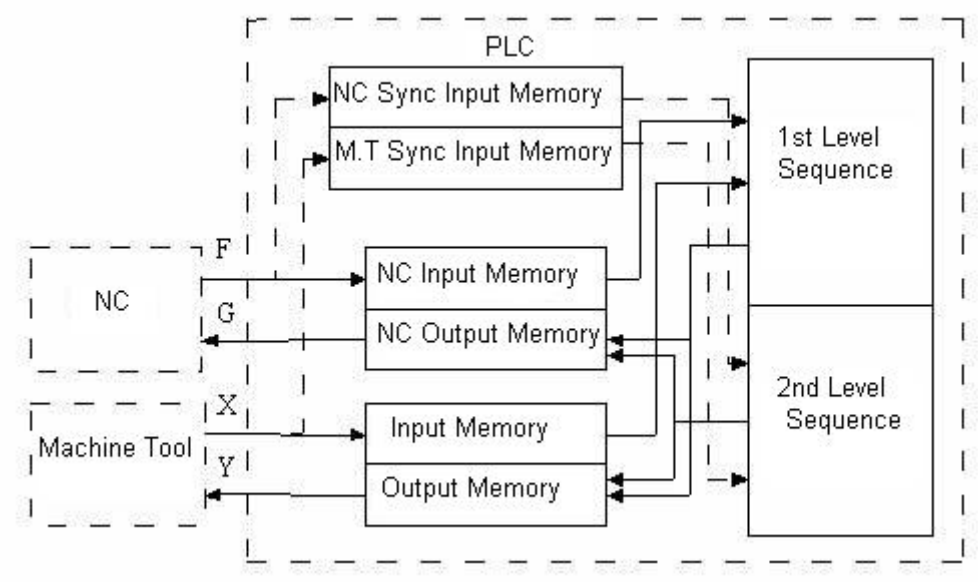
When the last division part of the 2nd sequence part has been executed, the program is re-executed from the beginning. The 1st level sequence part operates every 8ms; the 2nd level sequence part operates every 8n (ms); a loop execution time is 8n (ms).



3.3 Output/Input Signal Processing

X signal from machine tool and F signal from NC are input to the corresponding memory in PLC and adopted by the 1st level sequence part; meanwhile, they are input to the machine tool memory and NC memory and adopted by the 2nd level sequence part. The input signals are synchronized only in the 2nd level sequence part. The output signals of the 1st and 2nd level sequence parts are forwarded to the NC and machine tool memories, then to the I/O ports.

The signal status of NC input memory, NC output memory, machine tool input memory and machine tool output memory are displayed on the diagnosis screen.



3.3.1 Input Signal Processing

A: Input signal in the 1st level sequence part

F signals from NC are scanned and stored by the NC input memory at intervals of 8 ms. The 1st level sequence part directly applies these signals and process operations.

X signals from machine tool are scanned and stored by the machine tool input memory at intervals of 8 ms. The 1st level sequence part directly applies these signals and process operations.

B: The input signal in the 2nd level sequence part

The input signals in the 2nd level sequence part are the latched input signal in the 1st level sequence part. The F and X signals in the 1st level sequence part are directly adopted, therefore, the input signals in the 2nd level sequence part are lagged behind. The maximum lagging time is the 2nd level sequence part execution time.

C: The difference of input signal status between the 1st level and the 2nd level:

The status of the same input signal may be different in the 1st level and 2nd level sequence. That is, at the 1st level, processing is performed using input signal memory, and at the 2nd level, processing is performed using the 2nd level synchronous input signal memory. Therefore, it is impossible for a 2nd level input signal to delay by a cycle of 2nd level sequence execution at the worst, compared with a 1st level input signal. This must be kept in mind when writing the sequence program.

3.3.2 Output Signal Processing

A: Output signal to NC

PLC outputs signals to NC memory at the intervals of 8ms, then, NC memory directly outputs the signal to NC.

B: Output signal to machine tool

PLC outputs signals to the machine tool memory, then, the memory directly forwards the signals to

the machine tool at the intervals of 2ms.

3.3.3 Short Pulse Signal Processing

The 1st level sequence program is used to process the short pulse signal. However, if it is less than 8ms, it means the input signal status may be changed during the execution of the 1st level sequence program, which will cause mistake.

The remedy for such mistake is to store the signal in internal relay R when the signal is read, and during the next PLC program scanning period, take the R signal of buffer as the short pulse signal. In this way, the logic states of internal and external signals during a single PLC scanning period can be consistent.

3.3.4 Interlocking

Interlocking is externally important in sequence control safety. Interlocking with the sequence program is necessary. However, interlocking with the end of the electric circuit in the machine tool magnetics cabinet must not be forgotten. Even though logically interlocked with the sequence program (software), the interlock will not work when trouble occurs in the hardware used to execute the sequence program. Therefore, always provide an interlock inside the machine tool magnetics cabinet panel to ensure operator safety and to protect the machine from damage.

3.4 PLC Basic Instructions

Designing a sequence program begins with writing a ladder diagram. The ladder diagram is written using relay contact, symbols and function command codes. Logic written in the ladder diagram is entered as a sequence program. There are two sequence program entry methods. One is the entry method with PLC instructions. The other is the relay symbol method in which the sequence program is entered by using the relay contact, symbols and the function command symbols of the ladder diagram. When the relay symbol method is used, the ladder diagram format can be used and programming can be performed without understanding the mnemonic languages.

Actually, however, the sequence program entered by the relay symbol method can be realized through the following procedures:

3.4.1 Interfaces Assignment

After the control object specifications are certain and the number of input/output signal points is calculated, interfaces can be assigned. Refer to the input/output signal interface tables in the GSK988TA/988TA1/988TB user Manual for details.

3.4.2 Creation of Ladder Diagram

The control operation can be expressed in ladder diagram via the software GSKLadder. The edited ladder diagram can be downloaded to CNC via serial port or U disk for CNC read and execution.

3.4.3 Ladder Diagram Check

After the ladder diagram is downloaded to CNC, it can be checked with following methods: A: Check by simulator

Replace the machine tool with a simulator (consisting of lamps and switches). The ON/OFF of the switch represents the input signal status of machine tool; ON/OFF of lamp indicates the output signal status. Check the output signals on the basis of the activation of the lamps.

B: Check by CNC diagnosis

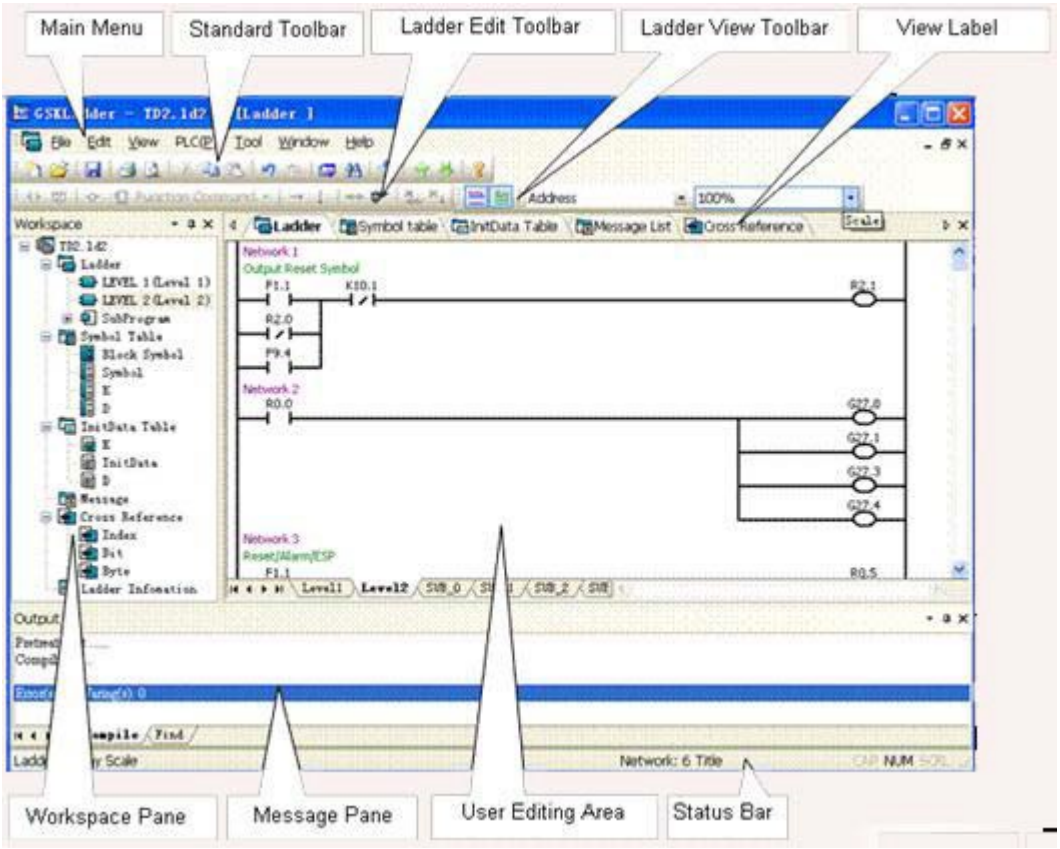
Perform different CNC functions to check whether the signal diagnosis status is consistent with the required function. Check the functions one by one to confirm the correctness of ladder diagram.

C: Check by actual operation

Perform checks by connecting the machine. Since sometimes unexpected operations may happen, arrange for safety before starting operations.

CHAPTER 4 INSTRUCTION OF GSKLADDER

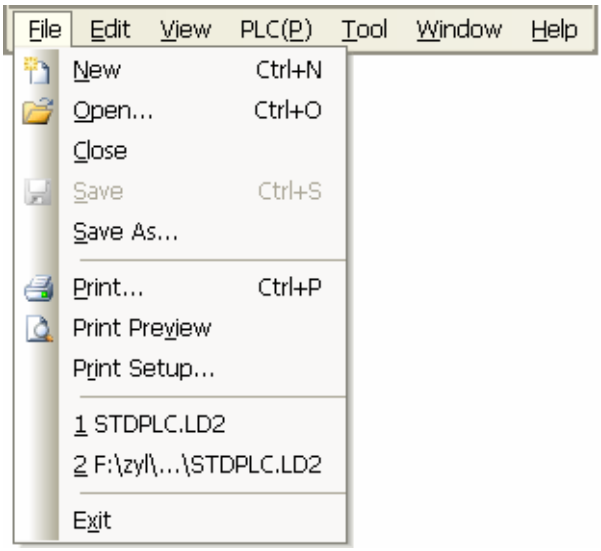
4.1 Screen Display



- Main Menu — All the operation commands
- Standard Toolbar — Daily-used commands
- Ladder Edit Toolbar — Ladder edit commands
- Ladder View Toolbar — Ladder display style
- View Label — Different views can be switched
- Workspace Pane — Different project configuration can be managed
- Message Pane — Outputs messages about PLC compiling and searching
- User Editing Area — Different views can be displayed, and the operations such as Ladder, Symbol Table and Initialized Data edit can be executed.
- Status Bar — To display the tool information, keyboard status and current cursor location etc.

4.2 Main Menu Commands

4.2.1 File Menu



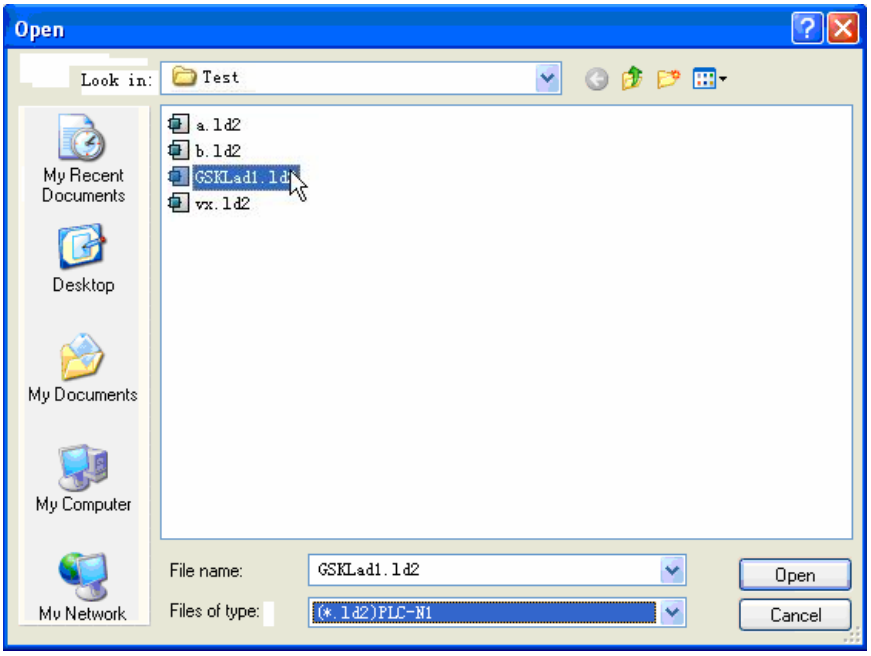
[New]

You can create a new project by using the keystroke of Ctrl+N, or clicking on the standard toolbar.

The newly created project will be named “GSKLad#” (# is a digit). The project should be stored in disk by clicking “Save”, then a “Save as” dialogue box will pop up. Enter a proper name and savepath, and then click “OK” to save.

[Open]

You can open an existing project by using keystroke of [Ctrl+O] or clicking on the standard toolbar, then, a dialogue box will pop up. Select the desired project, then, click [Open] to open the project.



[Close]

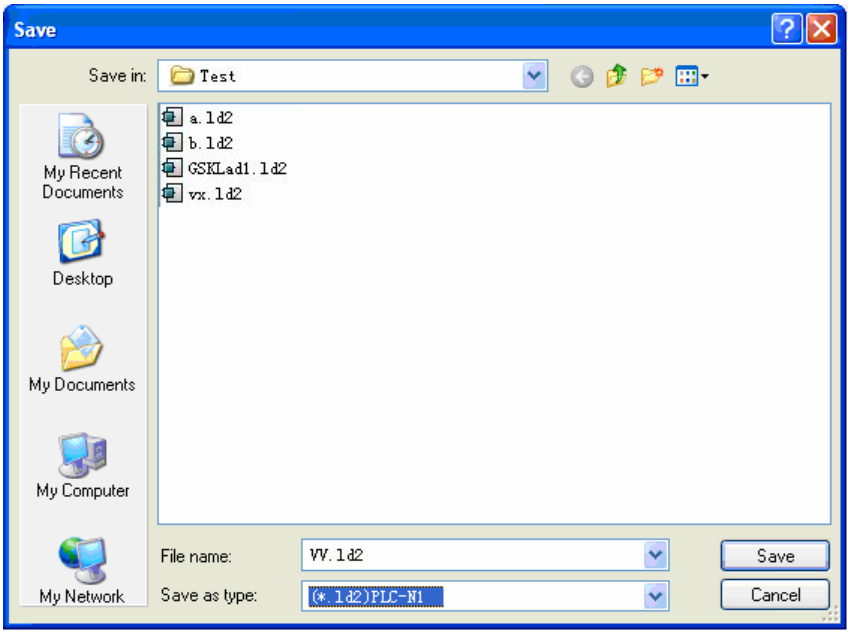
This command is used to close the current open project. If the project is not saved, a hint will pop up to confirm whether to save the current project.

[Save]

You can save the current open project by using keystroke of [Ctrl+S] or clicking on the standard toolbar.

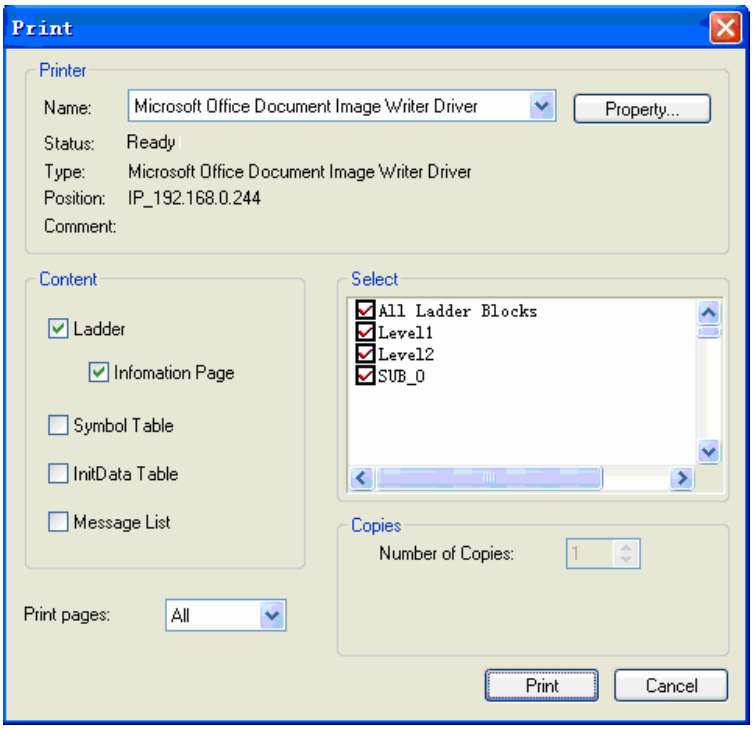
[Save As]

The current project can be backed up and saved as another file. When this command is executed, the following dialogue box will pop up. Fill in a proper name and save path, and then click “Save”.



[Print]

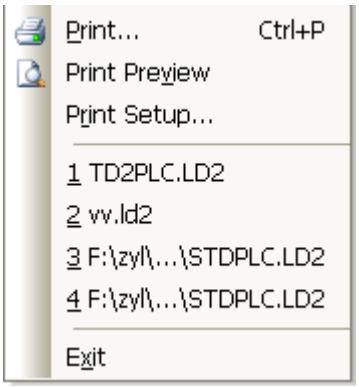
The current file can be printed through keystroke of [Ctrl+P] or clicking on the standard toolbar. In addition, a certain part of the contents within the current file can be selected. If the “Ladder” is selected, the blocks on the right list can also be selected.



[Print Preview]

It is used to preview the file before printing. Contents may vary in different views. For example, in the Ladder View, only ladder diagram is displayed; in Symbol Table View, only symbols are displayed. The style of ladder diagram is the same with the current view.

[Recent Open File List]

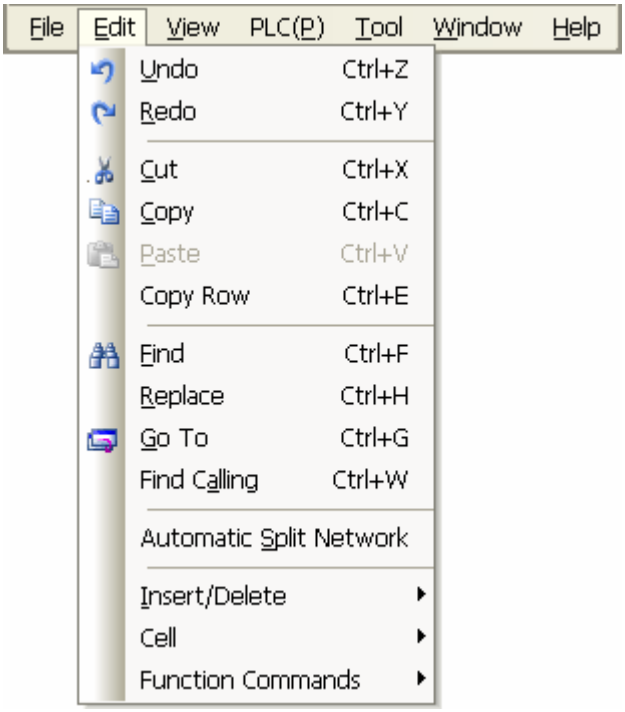


The list is the file names displayed below [Print Setting]. Four recent open projects can be listed and opened directly by clicking.

[Quit]

It is used to quit from the current project. If the project is not saved, a hint will pop up to confirm whether to save the current project.

4.2.2 Edit Menu



It should be noted that the last three items in “Edit” menu “Insert/Delete”, “Cell” and “Function Commands” are only displayed in the Ladder View.

[Undo]

You can undo the recent modified contents (up to 20 times) by using keystroke of [Ctrl+Z] or clicking on the standard toolbar.

[Redo]

You can redo the recent undone operation by using keystroke of [Ctrl+Y] or clicking on the standard toolbar. If the modification is made after the undo, Redo command cannot be executed.

[Cut]

You can cut the selected contents and copy it to the clipboard by using keystroke of [Ctrl+X] or clicking on the standard toolbar.

[Copy]

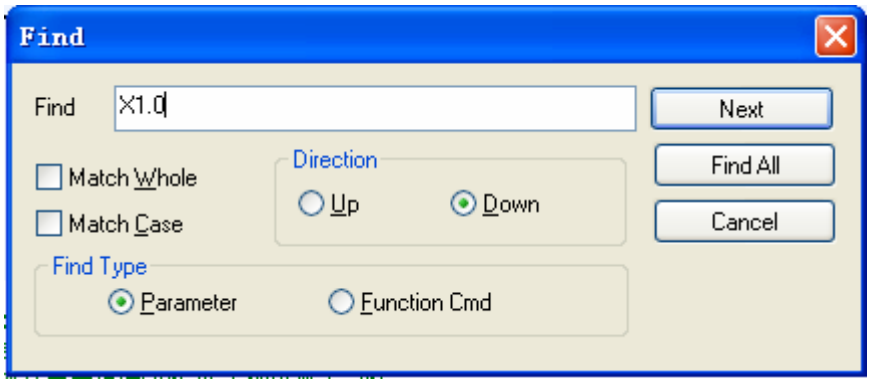
You can copy the selected contents in the clipboard by using keystroke of [Ctrl+C] or clicking on the standard toolbar.

[Paste]

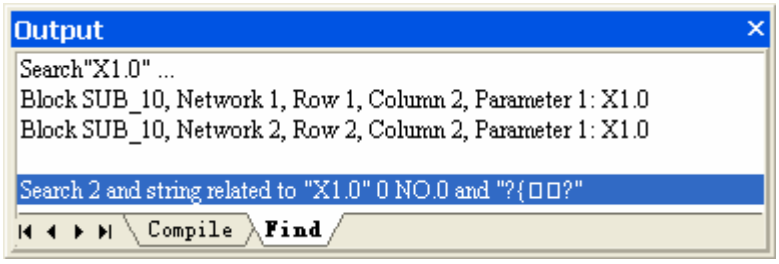
You can paste the contents in the clipboard to the selected position by using keystroke of [Ctrl+V] or on the standard toolbar.

[Find]

You can find contents such as the character string or address by [Find] command. Use keystroke of [Ctrl+F] or click the on the standard toolbar, then enter the contents to be found in the edit box. In Ladder View, you can select the Find Type the pop-up box, but in other views, it is not available.



Enter the contents to be searched in the edit box, then click [Next], the cursor will be located at the result position; if click [Find All], the results will be displayed in the information output pane; double-click one of the result, the cursor will be located at the corresponding contents. Shown as follows:

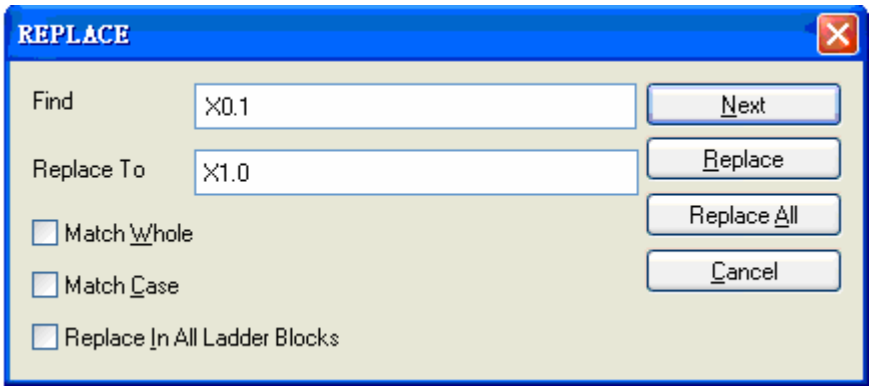

Output
Search"X1.0" ...
Block SUB_10, Network 1, Row 1, Column 2, Parameter 1: X1.0
Block SUB_10, Network 2, Row 2, Column 2, Parameter 1: X1.0
Search 2 and string related to "X1.0" 0 NO.0 and "?{□□?"
Compile
Find

In Ladder View, the type of parameters (constant, addresses or symbols) can be exclusively searched according to the input character string. The options such as “Exact Match” and “Match Case” are available only when the symbols or function commands are searched. “Match Case” is invalid when searching for addresses. Both “Exact Match” and “Match Case” are invalid when searching for constants. For address, formats “x0.1” and “X0000.1” represent the same one and will lead to the same result.

In Table View, all the contents are processed as character strings.

[Replace]

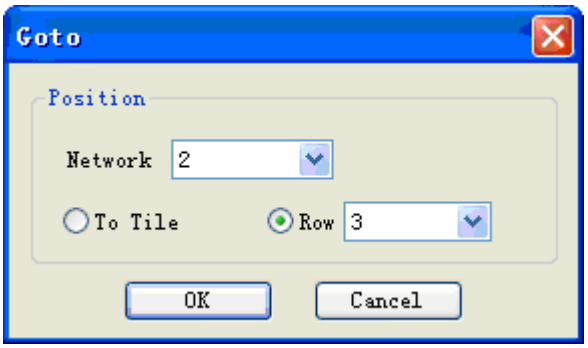
Specified contents can be replaced by new contents by using keystroke of [Ctrl+H]. The following dialogue box will pop up:



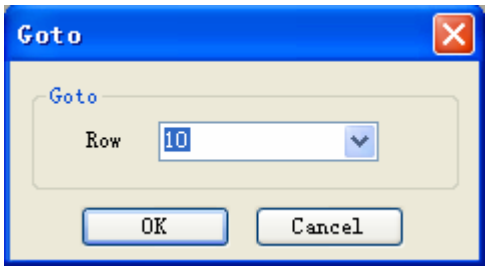
The find function in REPLACE dialogue box is the same as in [Find]. Replacement can be executed only when the search condition is fulfilled and the input content is legal. Address (or bit address) cannot be used to replace constant (or byte address), and vise versa.

[Goto]

Go to the designated location by using keystroke of [Ctrl+G] or the on the standard toolbar. A dialogue box will pop up. The dialogue box in Ladder View may be different from the one in other views. Shown as follows:



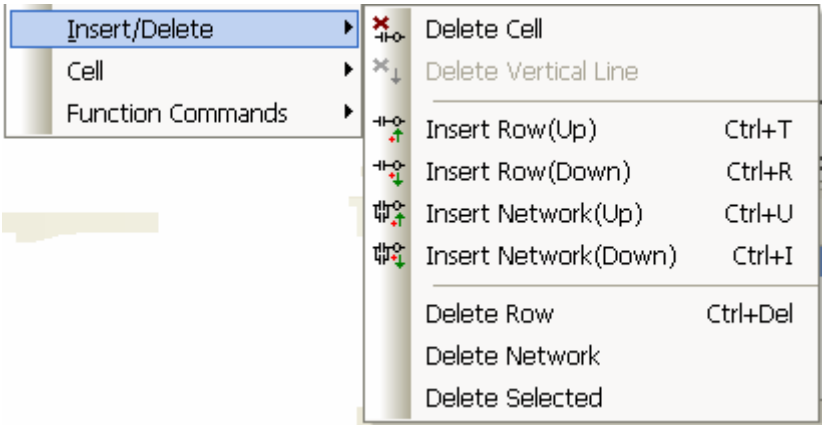
In Ladder View, select or input network position and row position in the dialogue box. The row position can be any row in the network or the network title (network title is the default row). Then, click [OK], the cursor will be located to the desired position.



In Table View, only rows are selectable in the dialogue box. Click [OK] after selection, then, the cursor will be located to the desired position.

[Insert/Delete]

There is a sub-menu subject to the [Insert/Delete]:



---- [Delete Cell]

Delete a cell of ladder diagram where the cursor located by using key [Delete] or clicking the on the Ladder Edit Toolbar.

---- [Delete Vertical Line]

Delete the vertical line on the left side of the cursor by clicking the on Ladder Edit Toolbar.

---- [Insert Row (Up)]

Insert a row above the cursor position by using keystroke of [Ctrl+T].

---- [Insert Row (Down)]

Insert a row below the cursor position by using keystroke of [Ctrl+ R].

---- [Inset Network (Up)]

Insert a network above the cursor position by using keystroke of [Ctrl+U].

---- [Inset Network (Down)]

Insert a network below the cursor position by using keystroke of [Ctrl+I].

---- [Delete Row]

Delete the row at cursor position. A blank row will be inserted if there is only one row in the current network.

---- [Delete Selected]

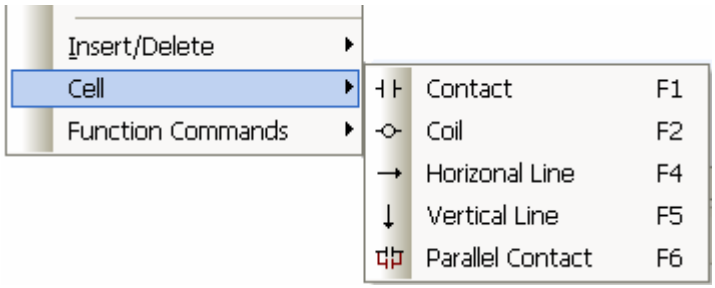
Delete the selected region by using key [Delete]. A network will be inserted if the current block is empty after deletion.

---- [Delete Network]

Delete the network at the cursor position.

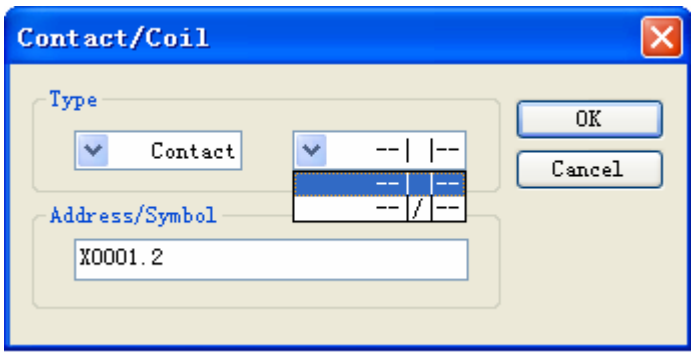
[Cell]

There is a sub-menu subject to the [Cell]. Shown as follows:



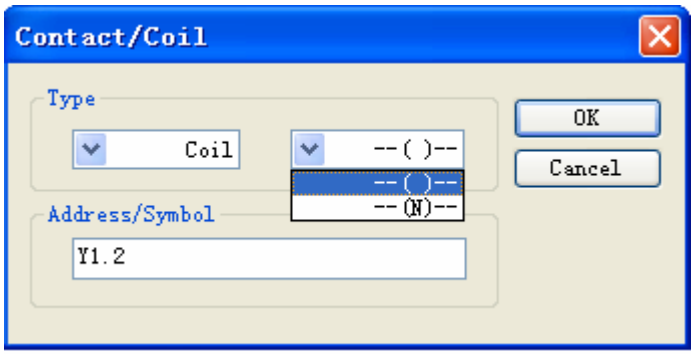
----[Contact]

Add a contact (normally-closed/normally-open contacts) by using key [F1] or clicking on the Ladder Edit Toolbar. A dialogue box will pop up for the setting of contact type and address/symbol.



---- [Coil]

Add an output coil at the selected position by using key [F2] or clicking on Ladder Edit Toolbar. A dialogue box will pop up for the setting of coil type and address/symbol.



---- [Horizontal Line]

Add a horizontal line at the selected position by using key [F4] or clicking on the Ladder Edit Toolbar.

---- [Vertical Line]

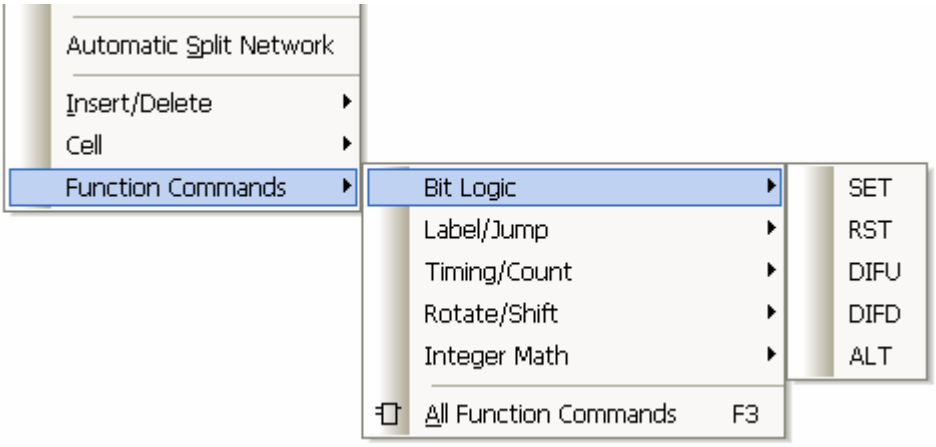
Add a vertical line right to the selected position by using key [F5] or clicking on the Ladder Edit Toolbar.

---- [Parallel Contacts]

Add a contact at the selected position and add vertical lines at two sides of the contact, so as to make it parallel to the contact in the above line. Using Key [F6] or clicking on the Ladder Edit Toolbar is the way to realize the operation.

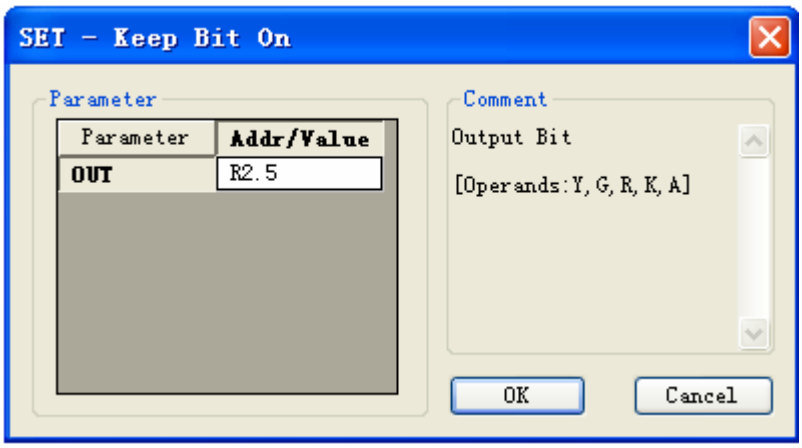
---- [Function Commands]

The sub-menu subject to [Function Commands] is shown as follows:



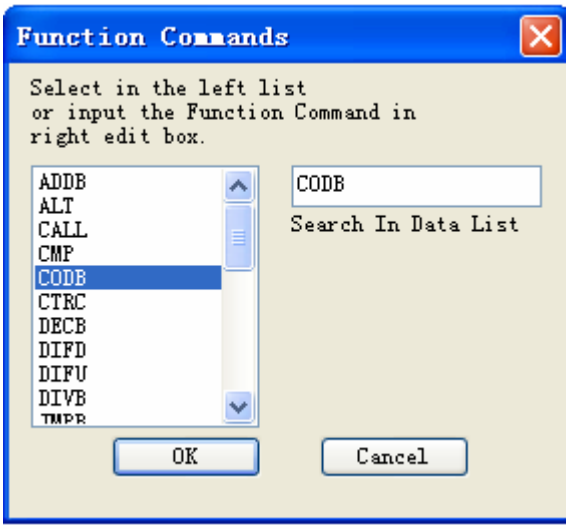
---- [Submenus]

There are five submenus including [Bit Logic], [Label/Jump], [Timing/Count], [Rotate/Shift], [Integer Math]. Each submenu contains multiple function commands. When one of the commands is selected, the edit window will pop up. Click [OK] after edition, then, the command will be added to the desired position. Take SET command for example, click [Edit]—[Function Commands]—[Bit Logic]—[SET], then, the following edit window will pop up. The left side of the window is parameter list. Parameter value can be entered in the second column and will be displayed in red when it is erroneous; the right side of the window is the comment for the selected parameter.



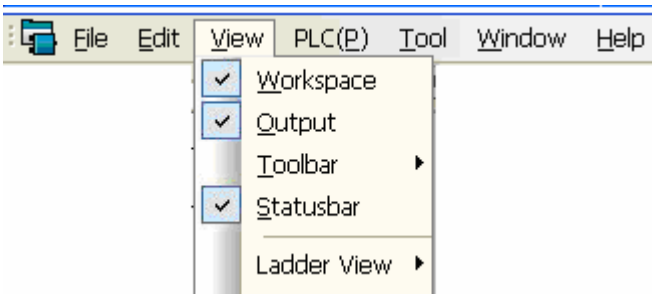
---- [All Function Commands]

You can also add function commands by clicking on the Ladder Edit Toolbar. A dialogue box will pop up for selection:



The function commands are selectable in the left side and can also be entered in the edit box. Double-click the command or click [OK] after entering the command. The execution result is the same as executing the commands in submenus.

4.2.3 View Menu



The last item in the menu [Ladder View] is displayed only in Ladder View.

[Workspace]

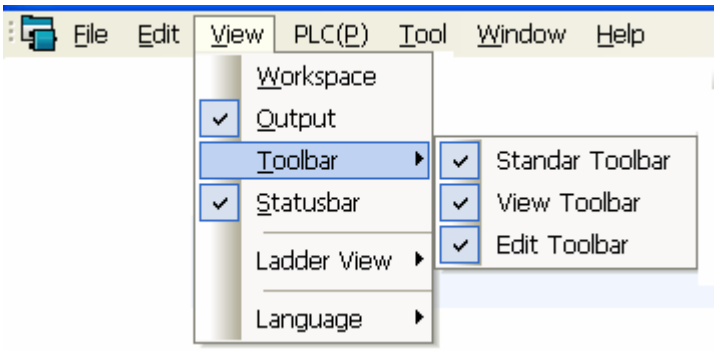
Display/Do not display the workspace pane.

[Output]

Display/Do not display the message output pane.

[Toolbar]

Display/Do not display the toolbar. The drop-down menu is shown as follows:



---- [Standard Toolbar]

Display/Do not display standard toolbar.

---- [View Toolbar]

Display/Do not display Ladder View toolbar.

---- Edit Toolbar]

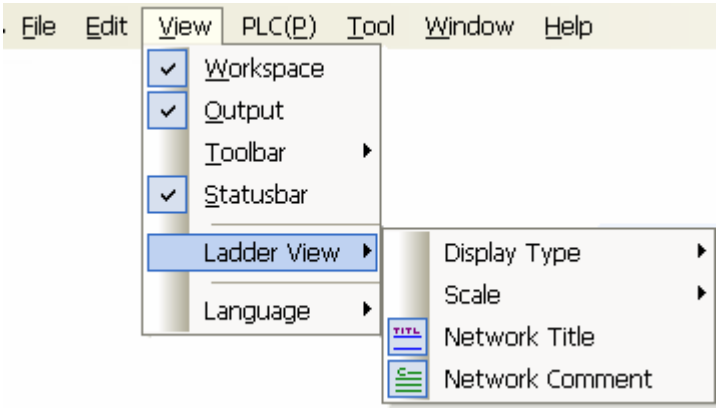
Display/Do not display Ladder Edit Toolbar.

[Status Bar]

Display/Do not display the status bar below the main frame window.

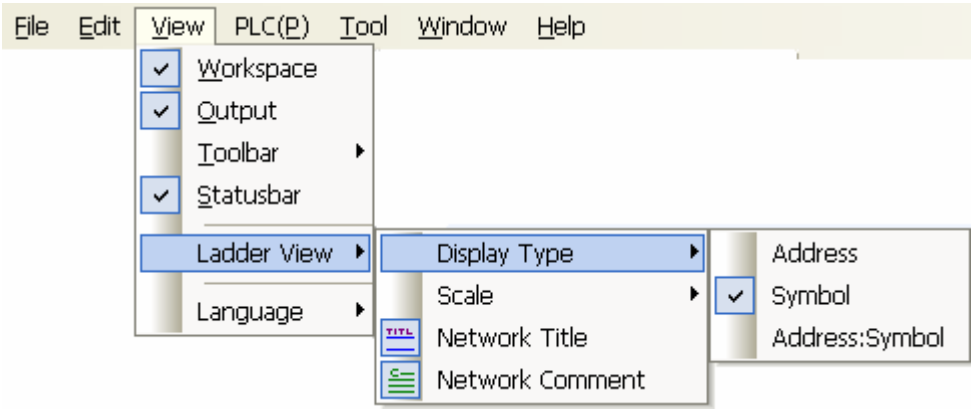
[Ladder View]

The drop-down menu for the setting of the Ladder View is shown as follows:

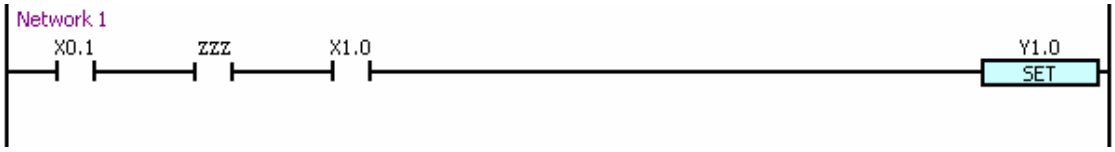


---- [Display Type]

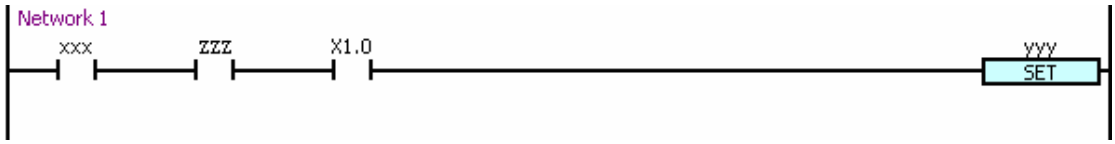
Parameters can be displayed in three types: “Address”, “Symbol”, “Address: Symbol”. They can also be set via the combobox on the Ladder View Toolbar. When display type “Address” is selected, parameters are displayed in addresses, except for those in the format of symbols and have no corresponding addresses (these symbols will be turned into blue if converted to addresses). When display type “Symbol” is selected, parameters are displayed in symbols, except for those whose type cannot be “Symbol”, such as address parameters (in addresses), and constants (in digits).



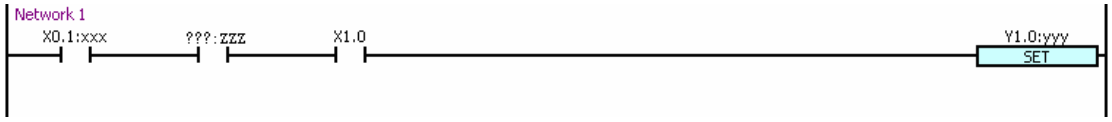
Displayed in “Address” type:



Displayed in “Symbol” type:

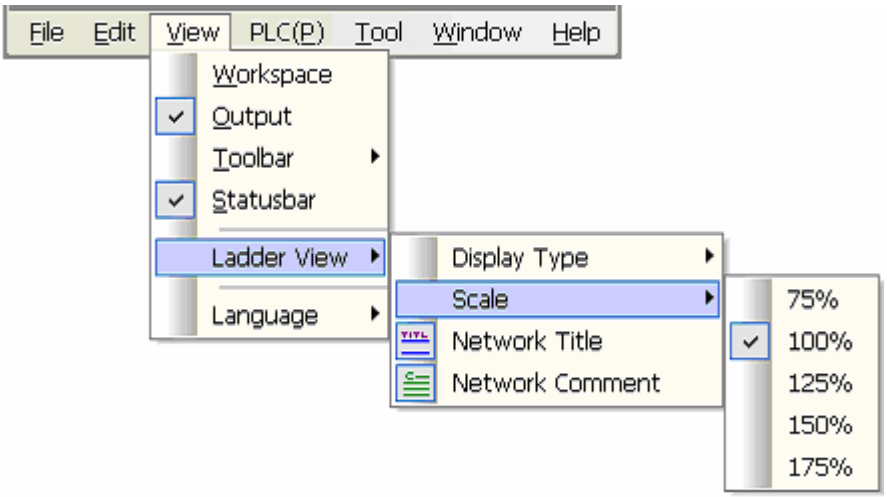


Displayed in “Address: Symbol” type:



---- [Scale]

The ladder display scaling ratio can be 75%, 100%, 125%, 150% or 175%. They can be set via the combobox on Ladder View Toolbar.



---- [Network Title]

Display/Do not display the network title through on Ladder View Toolbar.

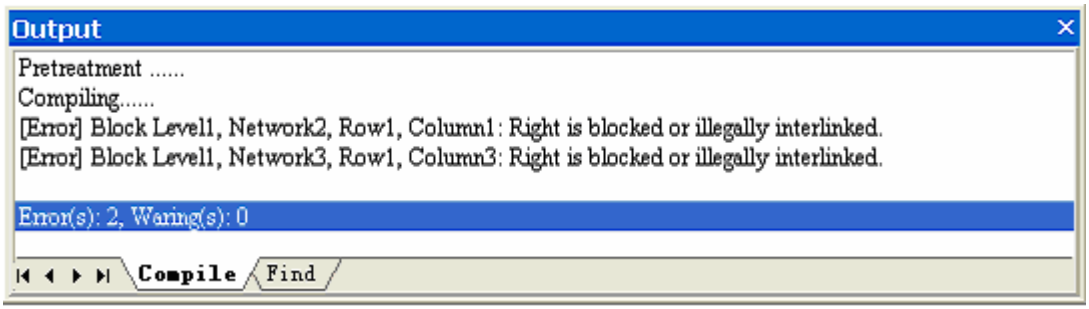
----[Network Comment]

Display/Do not display the network comment through on Ladder View Toolbar.

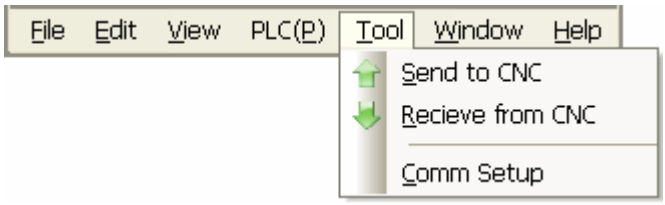
4.2.4 PLC Menu

[Compile]

Compile the current PLC programs via key F9 or on the standard toolbar. The information after compilation is displayed in the message output pane. Double-click the displayed error or alarm to trace the source.


Output
Pretreatment .....
Compiling.....
[Error] Block Level1, Network2, Row1, Column1: Right is blocked or illegally interlinked.
[Error] Block Level1, Network3, Row1, Column3: Right is blocked or illegally interlinked.
Error(s): 2, Waring(s): 0
Compile
Find

4.2.5 Tool Menu



[Send to CNC]

Send the files in current project to CNC for storage.

[Receive from CNC]

Read the PLC files from CNC into PC.

[Comm Setup]

Set serial port parameters including serial port number and communication baudrate.

4.3 Main Menu Commands

4.3.1 Standard Toolbar

Create a new project

Open an existing project

Save the current project

Print the ladder diagram

Print preview

Cut the selected area

Copy the selected area

Paste in the selected area

Undo the last operation

Redo previously "undone" operations

Goto the specified position

Find the designated contents

PLC compilation

Send current project to CNC

Receive PLC files from CNC

Display program information, version number and copyright.

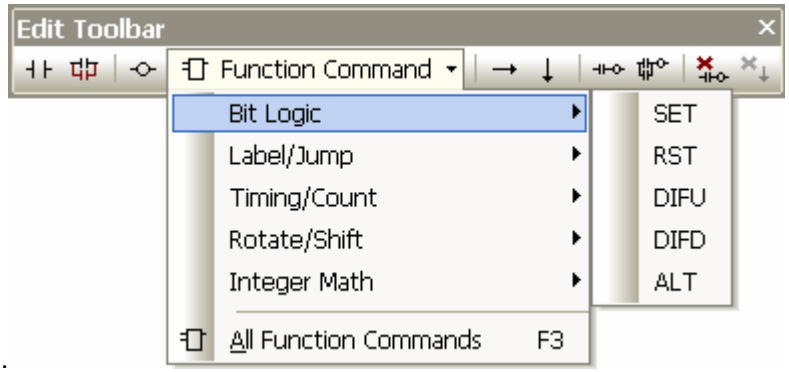
4.3.2 Ladder Edit Toolbar

Add contact at the cursor position (shortcut key F1)

Add serial contacts at the cursor position

Add output coil at the cursor position (shortcut key F2)

Function Command Add function commands at the cursor position. The function commands can be selected in the fly-out list



Add horizontal line at the cursor position (shortcut key F4)

Add vertical line at left side of cursor position (shortcut key F5)

Delete the selected ladder diagram cell (shortcut key Delete)

Delete the vertical line at the left side of the selected cell.

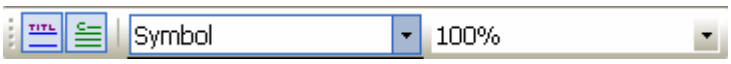
Add one row above the cursor position

Add one row below the cursor position

Add one network above the cursor position

Add one network below the cursor position

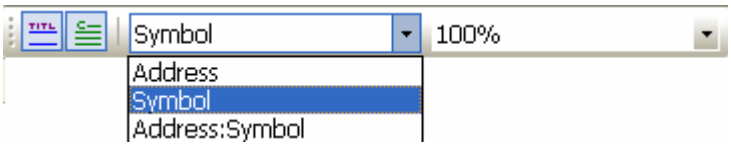
4.3.3 Ladder View Toolbar



Display/Do not display network title

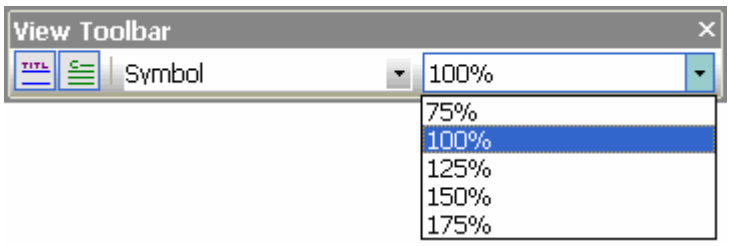
Display/Do not display network commend

Parameter display types combobox



Parameters can be displayed in three types: “Address”, “Symbol”, “Address: Symbol”. They can also be set via the on Ladder View Toolbar. When display type “Address” is selected, parameters are displayed in addresses, except for those in the format of symbols and have no corresponding addresses (these symbols will be turned into blue if converted to addresses). When display type “Symbol” is selected, parameters are displayed in symbols, except for those whose type cannot be “Symbol”, such as address parameters (in addresses), and constants (in digits).

Scaling combobox



The scaling ratio can be 75%, 100%, 125%, 150% or 175%. They can be set via the on Ladder View Toolbar.

4.4 Software Usage

The workspace is of tree structure. The project name is represented by root node which has 6 children: [Ladder], [Symbol Table], [InitData Table], [Message], [Cross Reference], [Ladder Information]

[Ladder]

It consists of [Level 1], [Level 2] and [subprogram]. The tree node number subject to the [Subprogram] is not limited and can be added or deleted.

[Symbol Table]

It consists of [Block Symbol] and some user-defined symbol table nodes. The nodes in [Block Symbol] are fixed while the node number of user-defined symbol is related to the number of symbol tables.

[InitData Table]

It consists of [K Value Setting] and some user-defined symbol table nodes. The nodes in [K] are fixed while the node number of user-defined data table is related to the number of data tables. **[Message]**

It has no branch node, which means only one message table can be displayed.

[Cross Reference]

It consists of three children: [Index], [Bit], [Byte] which cannot be deleted or edited. Node cannot be added to the cross reference.

[Ladder Information]

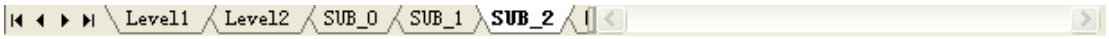
It is a fixed node without child.

4.4.1 View－Open and Switch

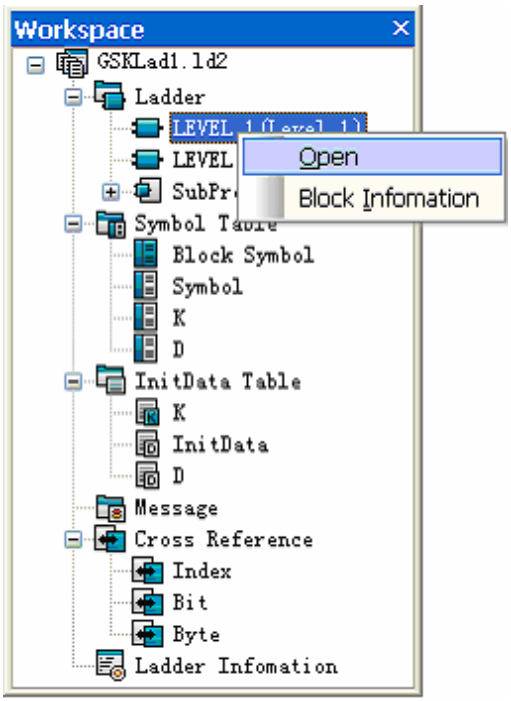
There are three ways to switch among views: double-click the tree node in project manager; click the [Open] in Workspace Pane tree note; click the view switch label on the top or bottom of the user edit area.

View switching label

Sub-view switching label



Command [Open] on the Workspace tree note



4.4.2 Ladder

After a project is open, the current view is the Level 1 of Ladder. You can switch among different blocks and views. The operations of menus and toolbars are described in previous sections. The following paragraphs are about the subprogram creation, rename, deletion, block message edit and network note addition.

4.4.2.1 Create, Rename or Delete a Subprogram

Create a subprogram

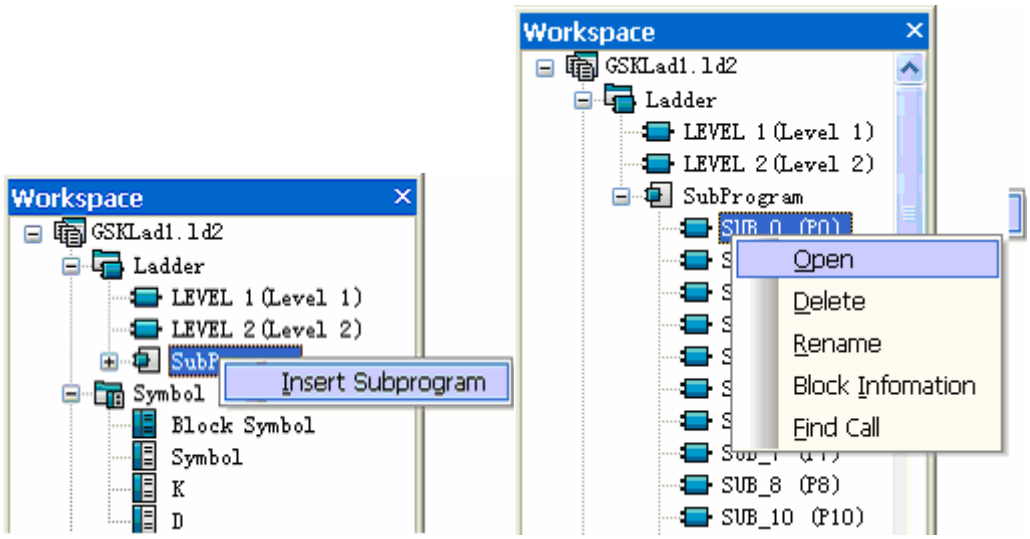
Click command [Insert Subprogram] after right-clicking [Subprogram] node, a new subprogram will be generated, which, at the mean time, enables the generation of a new node and a sub-view label.

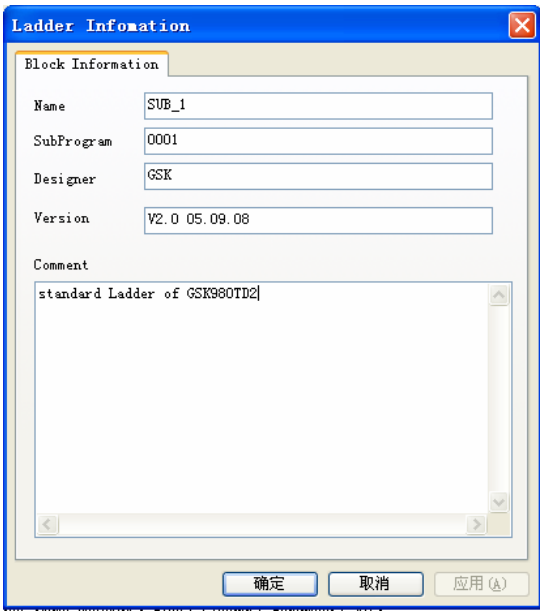
Rename a subprogram

Expand the [Subprogram] by clicking the + symbol, then, click [Rename] on the fly-out menu, or left-click the sub-node to be renamed, the character string becomes editable, then press “Enter” on the keyboard. Please note that the new name cannot be consistent with other names of blocks (including level 1 and level 2 programs).

Delete a subprogram

Click [Delete], a dialogue box will pop up to confirm the deletion, then, the corresponding subprogram will be deleted if your answer is yes.



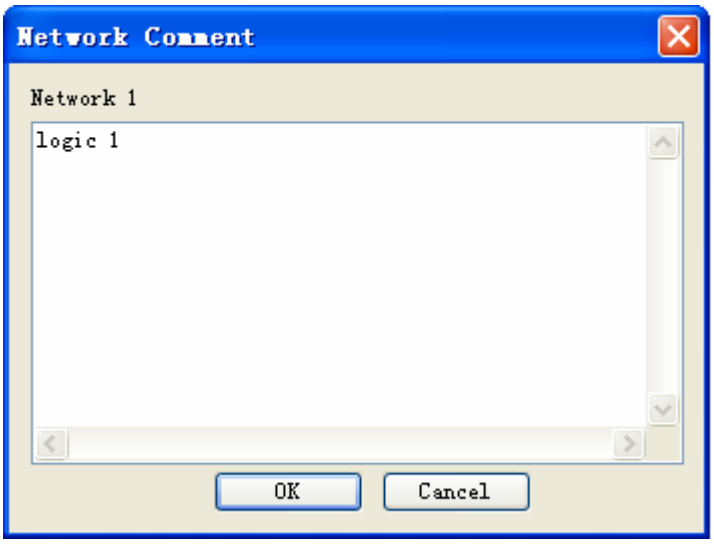


4.4.2.2 Modify Block Information

Click [Block Information] in the fly-out menu, a dialogue box will pop up. Click [OK] after editing proper information, otherwise, click [Cancel] to close the dialogue box.

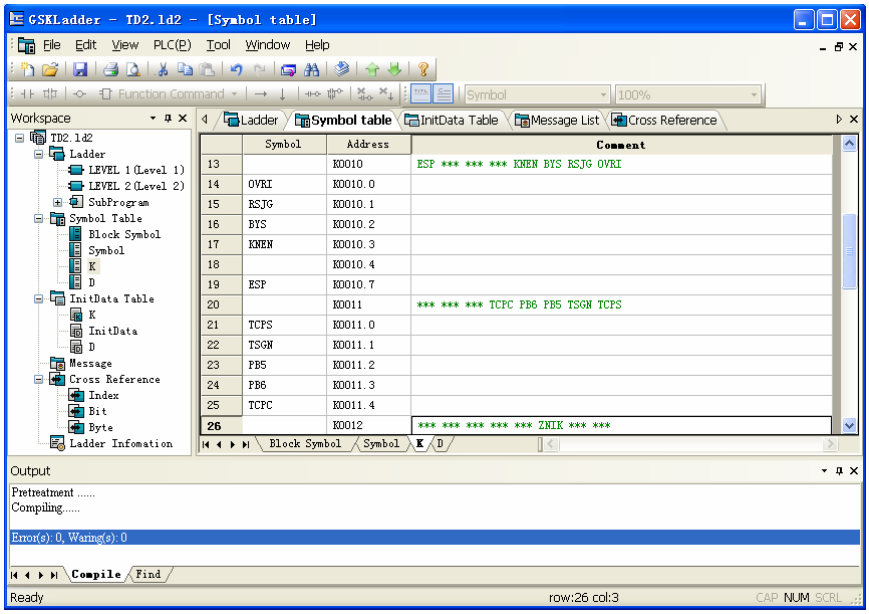
4.4.2.3 Add Network Comment

Double-click the network title in Ladder View; the following dialogue box will pop up. Modify the network comment in edit box and then click [OK] to validate it, or click [Cancel] to close the dialogue box.



4.4.3 Symbol Table

Click [Symbol Table] to switch to the symbol table view frame. You can switch among different symbol tables by clicking different sub-view labels.



The main effect of symbol table is to realize the mapping between symbol and address. This kind of mapping relationship enables the user to replace addresses by symbols during PLC programming. The symbol table can be deleted and added, except for the table “Block Symbol” which is fixed and not editable. It is used to display the mapping relationship between subprogram name and subprogram address, thus, the subprogram name can also used as a symbol. Other symbol tables are user-defined. The following paragraphs describe how to create and delete a symbol table.

4.4.3.1 Create, Rename and Delete a Symbol Table

Create a symbol table

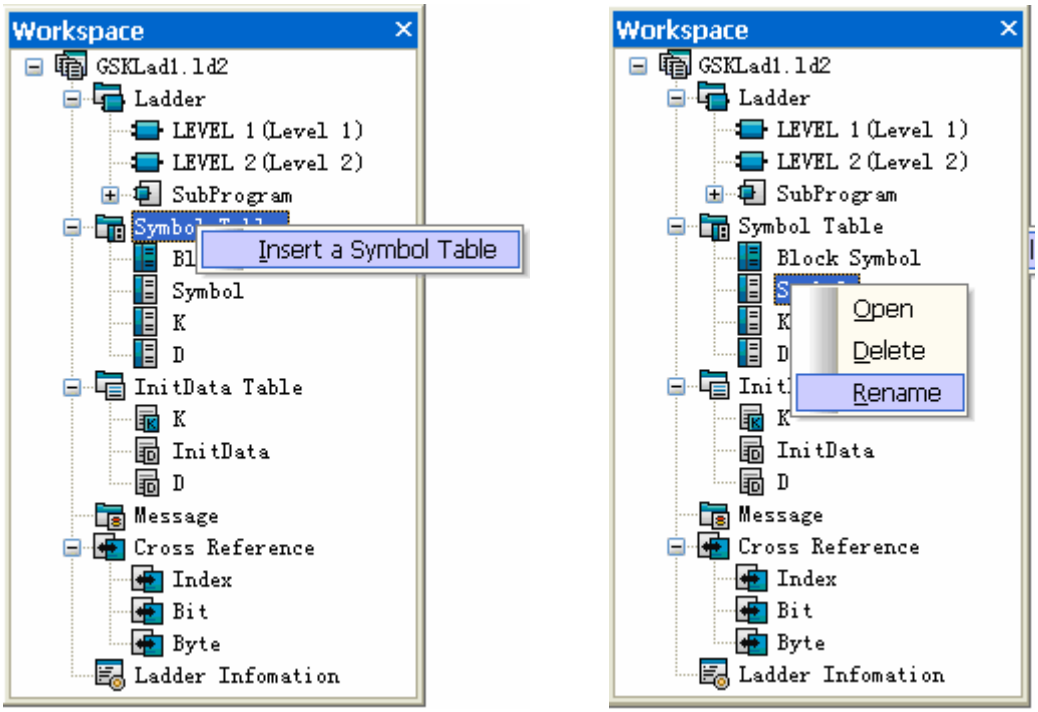
Click command [Insert Symbol Table] after right-clicking [Symbol Table] node, a new symbol table will be generated, which, at the mean time, enables the generation of a new node and a sub-view label.

Rename a symbol table

Expand the [Symbol Table] by clicking the + symbol, then, click [Rename] on the fly-out menu, or left-click the sub-node to be renamed, the character string becomes editable, then press “Enter” on the keyboard. Please note that the new name cannot be consistent with other names of symbol tables.

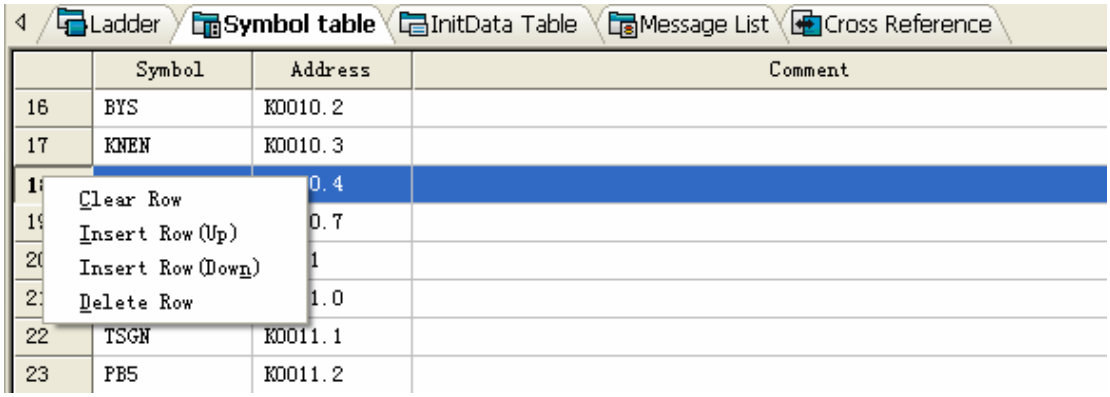
Delete a symbol table

Click [Delete], a dialogue box will pop up to confirm the deletion, then, the corresponding symbol table will be deleted if your answer is yes.



4.4.3.2 Symbol Table Edit

Edit of Rows: Right-click a row header of the symbol table, a menu will pop up. Click [Clear Row], the contents in the row will then be cleared; click [Insert Row (Up)] to insert a row above the current position; click [Insert a Row (Down)] to insert a row below the current position; click [Delete Row] to delete the selected row.



Symbol input

The format of input symbol is limited within letters, digits, underlines and Chinese characters. Digit

should not be the head and the total length of a symbol should not exceed 32 characters. Symbols should not be identical to each other; otherwise, a hint will remind you the existence of such symbol.

Address input

The format of address is also limited. The format of byte address is: type (letter)+address number (digit); the formation of bit address is: type (letter) + address number (digit)+ "." + bit number (digit). The allowable input types are: A, X, Y, R, K, F, C, T, D, DT, DC. The addresses should not be the same; otherwise, the same addresses will be displayed in green for identification.

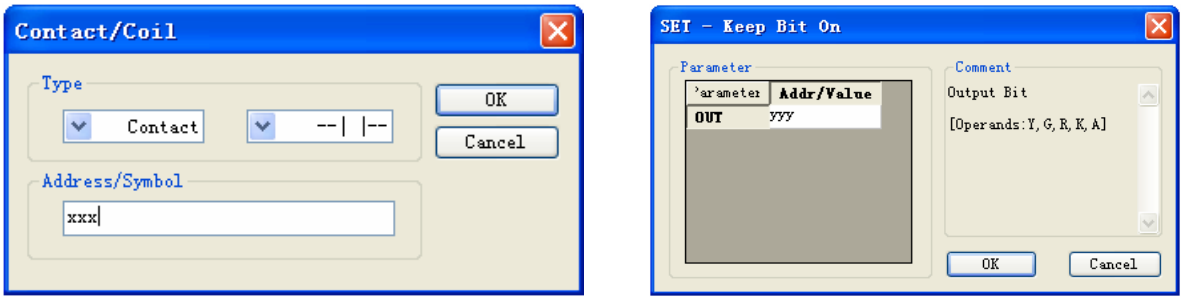
Comment input

Note should be limited within 127 bytes, but the contents and format are not limited and can be empty as well.

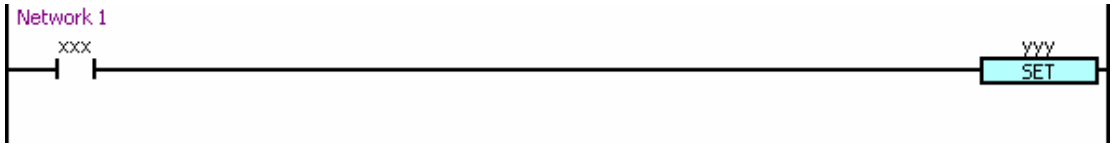
There is exceptionality: it is allowable to input address and note without symbol. It can be regarded as note for the address; however, it is not allowed to input symbol instead of address, the symbol is regarded as invalid.

4.4.3.3 Usage of Symbols

The usage of symbol is pretty easy. When you edit cell, just input a symbol as a parameter. Symbols can be used before they are defined.



When a parameter is displayed in "Address" view, the symbols which represent the parameter are displayed in blue; if the symbols are invalid or undefined, they are displayed in red. In "Symbol" view or "Address: Symbol" view, symbols are black when the parameter is correct; when the mapping address type is not the required one, the symbol is orange; symbols are red when they are incorrect or undefined.



4.4.4 InitData Table

Click [InitData Table] label to switch to the corresponding frame window which includes two different edit screens: parameter screen and table screen. Parameter K screen is used to set the K value and data table screen is used to input the initialized data of D, DT and DC. The default screen is "K value

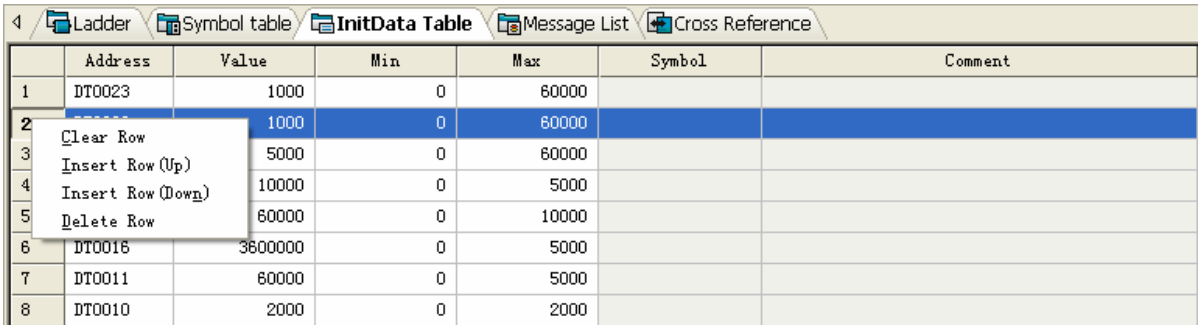
setting" which is fixed and un-removable (see Fig. 1-17). Except for K value, other values are addable and deletable.

4.4.4.1 K Value Setting

The parameter page for K value setting consists of parameters sorted by column. Each parameter consists of sequence number and data. As the parameters cannot be displayed in one page, they may be divided into several pages, and the page number and parameter numbers of each page depend on the size of view area. Turn the pages by clicking the forward or backward buttons on the lower-right corner or pressing [PageUp] and [PageDown]. There are two lines of notes in green at the bottom of the page, one is the note for bit, and the other is the notes for individual parameter. These notes are not preset in the software but user-defined, which means users can add or edit these notes in symbol table.

K value setting is edited in bits. To modify a bit, you need to double-click the bit or move cursor the bit then press [Enter].

4.4.4.2 Edit of InitData Table (D, DT, DC)



Edit of Rows

Right-click a row header of the InitData Table, a menu will pop up. Click [Clear Row], the contents in the row will then be cleared; click [Insert Row (Up)] to insert a row above the current position; click [Insert a Row (Down)] to insert a row below the current position; click [Delete Row] to delete the selected row.

Address Input

The address input is similar to the input in the symbol table, but only types D, DC, DT are supported in InitData Table.

Data Input

The input data should be set between the data range and will be clamped at the upper limit or the lower limit if exceeds. Integers from -2147483647 to 2147483647 can be input if no upper or lower limit is set.

Minimum Data Input

Integers from -2147483647 to 2147483647 can be input if no upper or lower limit is set. If the maximum data exists, the input data should be limited within -2147483647 to the maximum data. If the input data is smaller than -2147483647, it is clamped at -2147483647; if it is greater than the maximum data, it is clamped at the maximum data. If the modified minimum data is greater than the input data, the input data will be re-set to the modified one.

Maximum Data Input

Integers from -2147483647 to 2147483647 can be input if no upper or lower limit is set. If the

minimum data exists, the input data should be limited within the minimum data to2147483647. If the input data is greater than 2147483647, it is clamped at 2147483647; if it is smaller than the minimum data, it is clamped at the minimum data. If the modified maximum data is smaller than the input data, the input data will be re-set to the modified one.

4.4.4.3 Create, Rename or Delete InitData Table

Create an InitData Table

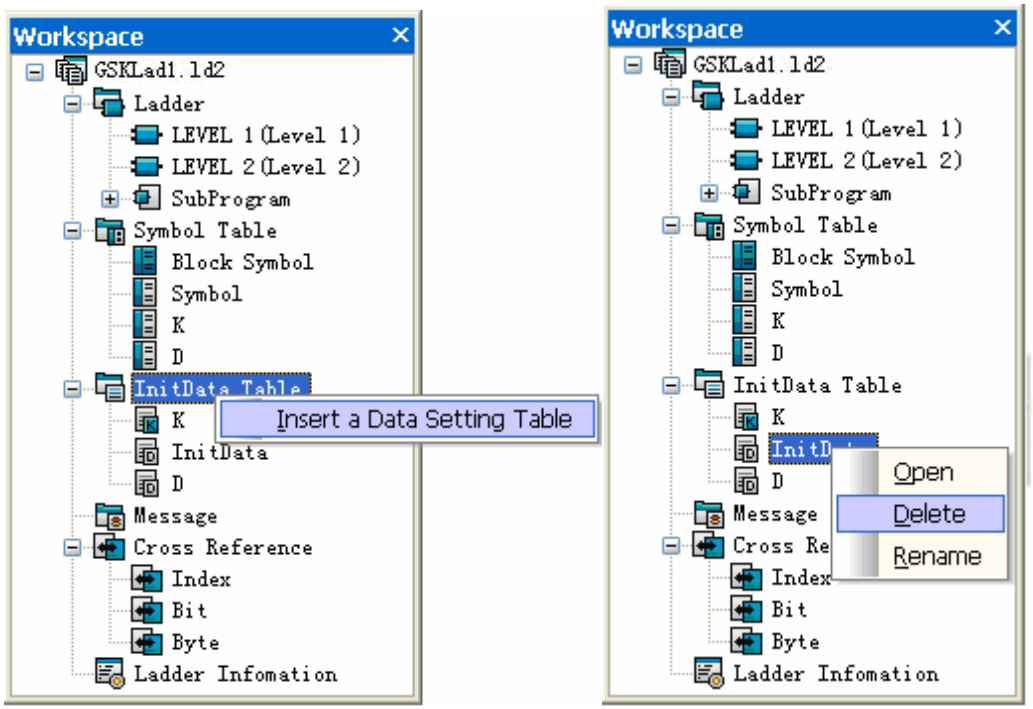
Click [Insert a Data Setting Table] after right-clicking the [InitData Table] node, a new subprogram will be generated, which, at the mean time, enables the generation of a new node and a sub-view label.

Rename an InitData Table

Expand the [InitData Table] by clicking the + symbol, then, click [Rename] on the fly-out menu, or left-click the sub-node to be renamed, the character string becomes editable, then press “Enter” on the keyboard. Please note that the new name cannot be consistent with other names of tables (including “K value setting” table).

Delete an InitData Table

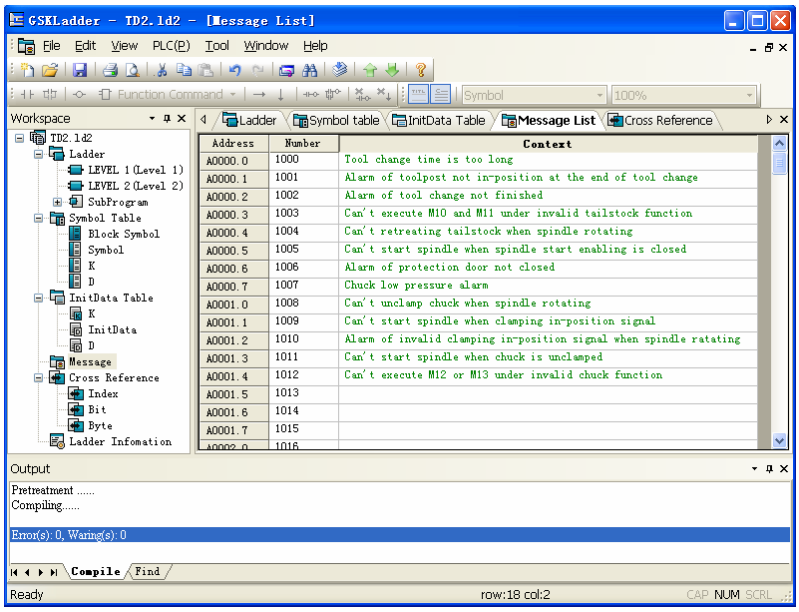
Click [Delete], a dialogue box will pop up to confirm the deletion, then, the corresponding table will be deleted if your answer is yes.



4.4.5 Message List

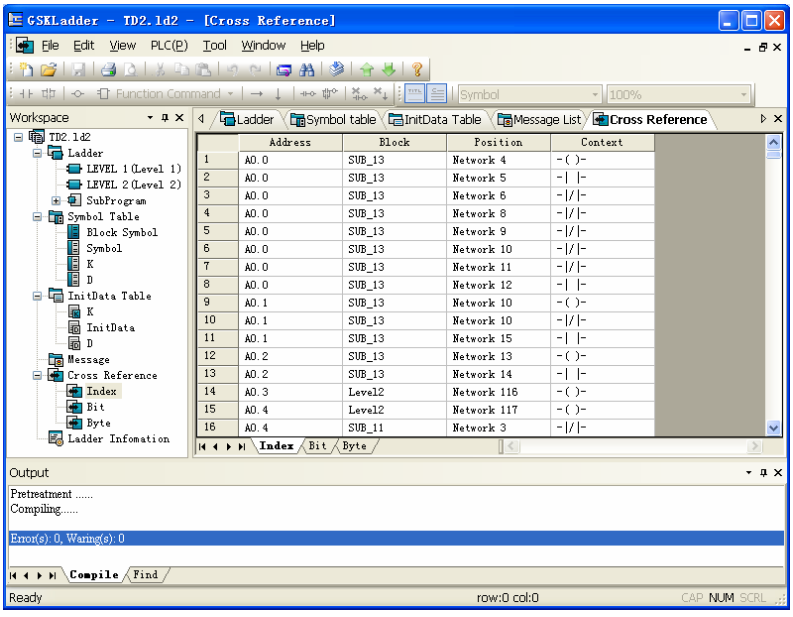
Click [Message List] label. The displayed message list contains 200 rows which cannot be added or deleted. The address is listed from A0000.0 to A0024.7, and cannot be added or deleted neither. The alarm number range is 1000~9999 without the same data. Both the alarm number and displayed contents

should be input indispensably; otherwise, an alarm will occur during compiling.


GSKLadder - TD2.ld2 - [Message List]
File Edit View PLC(P) Tool Window Help
Workspace
Ladder Symbol table InitData Table Message List Cross Reference
Address Number Context
A0000.0 1000 Tool change time is too long
A0000.1 1001 Alarm of toolpost not in-position at the end of tool change
A0000.2 1002 Alarm of tool change not finished
A0000.3 1003 Can't execute M10 and M11 under invalid tailstock function
A0000.4 1004 Can't retreating tailstock when spindle rotating
A0000.5 1005 Can't start spindle when spindle start enabling is closed
A0000.6 1006 Alarm of protection door not closed
A0000.7 1007 Chuck low pressure alarm
A0001.0 1008 Can't unclamp chuck when spindle rotating
A0001.1 1009 Can't start spindle when clamping in-position signal
A0001.2 1010 Alarm of invalid clamping in-position signal when spindle ratating
A0001.3 1011 Can't start spindle when chuck is unclamped
A0001.4 1012 Can't execute M12 or M13 under invalid chuck function
A0001.5 1013
A0001.6 1014
A0001.7 1015
Output
Pretreatment .....
Compiling.....
Error(s): 0, Waring(s): 0
Compile Find
Ready row:18 col:2

4.4.6 Cross Reference List

Click [Cross Reference] label. It is used to show the addresses using and assignment conditions in PLC. It includes “Index”, “Bit” and “Byte” three lists which are uneditable and usually empty. The relevant information is generated only after compilation. The contents in the three lists will be cleared once the projected is modified.


GSKLadder - TD2.ld2 - [Cross Reference]
File Edit View PLC(P) Tool Window Help
Workspace
Ladder Symbol table InitData Table Message List Cross Reference
Address Block Position Context
1 A0.0 SUB_13 Network 4 -( )-
2 A0.0 SUB_13 Network 5 -| |-
3 A0.0 SUB_13 Network 6 -|/|-
4 A0.0 SUB_13 Network 8 -|/|-
5 A0.0 SUB_13 Network 9 -|/|-
6 A0.0 SUB_13 Network 10 -|/|-
7 A0.0 SUB_13 Network 11 -|/|-
8 A0.0 SUB_13 Network 12 -| |-
9 A0.1 SUB_13 Network 10 -( )-
10 A0.1 SUB_13 Network 10 -|/|-
11 A0.1 SUB_13 Network 15 -| |-
12 A0.2 SUB_13 Network 13 -( )-
13 A0.2 SUB_13 Network 14 -| |-
14 A0.3 Level2 Network 116 -( )-
15 A0.4 Level2 Network 117 -( )-
16 A0.4 SUB_11 Network 3 -|/|-
Index Bit Byte
Output
Pretreatment .....
Compiling.....
Error(s): 0, Waring(s): 0
Compile Find
Ready row:0 col:0

4.4.6.1 Index List

It is used to display the context of referenced address, so that a user can find the address position with ease. There are five columns in the list: row header, address, block, position and context. Double-click the corresponding table cells to goto the desired position.

4.4.6.2 Bit List

It is used to display the bit address condition in PLC. The row header of the list indicates the byte part of the address and the eight columns that followed indicate the condition of bits. If a column is marked with 'X', it means the corresponding bit address is occupied. For example, "A0000._", the last column of the row, i.e. the column headed with "0", is marked with "X", indicating that address A0000.0 is occupied. Please note that not all the bit addresses are list unless one of the bits is occupied. If an address is not listed, it means the address is not used.

Bit	7	6	5	4	3	2	1	0
A0000._	X	X	X	X	X	X	X	X
A0001._		X	X	X	X	X	X	X
A0002._	X	X	X	X	X			X
F0000._		X	X	X				
F0001._			X		X		X	X
F0002._	X				X			
F0003._		X	X		X	X	X	X

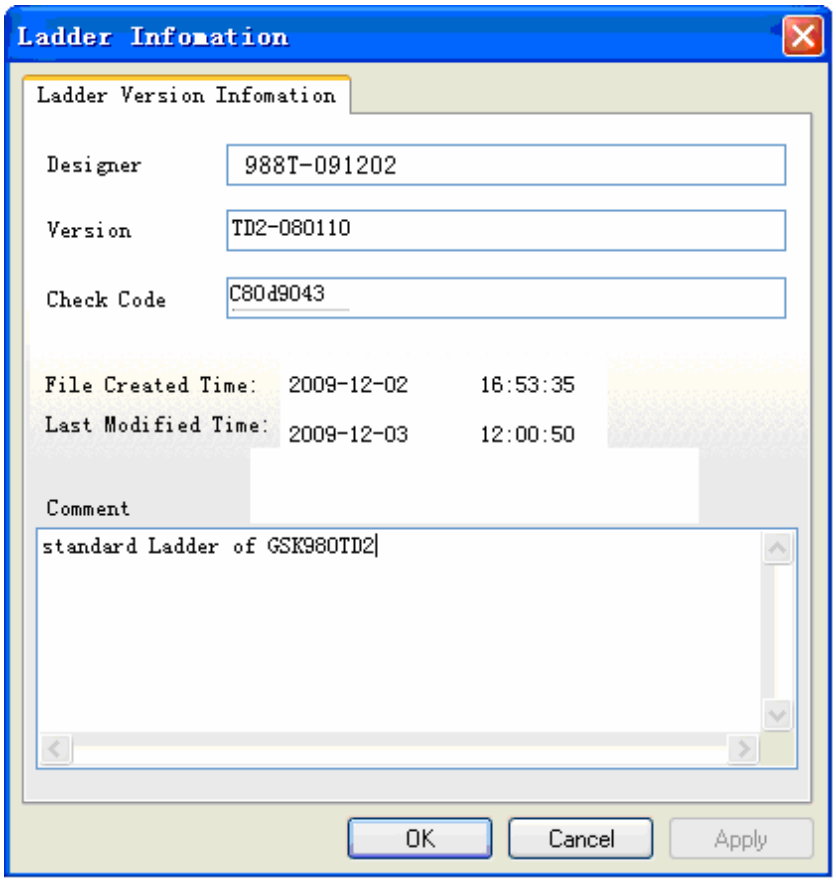
4.4.6.3 Byte List

It is used to display the byte address condition in PLC. The row header of the list indicates the part aside from single digits and the ten columns that followed indicate single digits. For example,"C000_", the column header of the row is 9, indicating that the cell represents address C0009. An occupied cell is marked with "X". Please note that not all the addresses are list unless it is occupied. If an address is not listed, it means the address is not used.

字 节	0	1	2	3	4	5	6	7	8	9
C000_					X					
F001_	X									
F002_			X				X			
F020_								X		
F021_						X				
G001_	X		X							
G003_	X		X							
G004_				X						

4.4.7 Ladder Information

Double-click [Ladder Information] on the workspace tree node, or right-click it, then click command [Open], a dialogue box will pop up (see the following figure). You can enter the information in "Designer", "Version" and "Comment". The input format is not restricted but the character number is limited (63 characters in "Designer", 19 characters in "Version", 511 characters in "Comment"). The Check Code is the 32-bit CRC checksum of PLC file, and it can be seen only when the project is not modified or is saved after modification.


Ladder Infomation
Ladder Version Infomation
Designer
988T-091202
Version
TD2-080110
Check Code
C80d9043
File Created Time:
2009-12-02
16:53:35
Last Modified Time:
2009-12-03
12:00:50
Comment
standard Ladder of GSK980TD2
OK
Cancel
Apply

APPENDIX 1 G Signals List

Address	Signal	Symbol	Section
G4.3	Auxiliary function completion signal	FIN	2.7.4.1
G4.4	The 2M function completion signal	MFIN2	2.7.4.2
G4.5	The 3M function completion signal	MFIN3	2.7.4.2
G5.0	M function completion signal	MFIN	2.7.4.1
G5.2	Spindle function completion signal	SFIN	2.7.4.1
G5.3	Tool function completion signal	TFIN	2.7.4.1
G5.6	Miscellaneous function lock signal	AFL	2.7.5.1
G6.2	Manual absolute signal	ABSM	2.5.7.1
G6.4	Override cancel signal	OVC	2.6.4
G7.2	Cycle start signal	ST	2.5.1.1
G7.4	Stroke check 3 release signal	RLSOT3	2.2.6.3
G7.6	Stored limit selection signal	EXLM	2.2.6.2
G8.4	Emergency stop signal	ESP	2.2.1
G8.5	Feed dwell signal	SP	2.5.1.2
G8.6	Resetting rewinding signal	RRW	2.5.2.3
G8.7	External reset signal	ERS	2.5.2.1
G9.0 G9.1 G9.2 G9.3 G9.4	External workpiece index signal	PN1,PN2,PN4,PN8, PN16	2.5.2.4
G10,G11	Manual rapid traverse override signal	JV0 ~ JV15	2.3.1.2
G12	Feedrate override signal	FV0 ~ FV7	2.6.3
G14.0, G14.1	Rapid traverse override signal	ROV1, ROV2	2.6.2
G18.0 ~ G18.3	MPG1 feed axis selection signal	HS1A ~ HS1D	2.3.2.1
G18.4 ~ G18.7	MPG2 feed axis selection signal	HS2A ~ HS2D	2.3.2.1
G19.4, G19.5	MPG/STEP override signal	MP1, MP2	2.3.2.2
G19.7	Manual rapid traverse selection signal	RT	2.3.1.3
G27.0	The 1st spindle selection signal	SSW1	2.8.2
G27.1	The 2nd spindle selection signal	SSW2	2.8.2
G27.3	The 1st spindle stop signal	SSTP1	2.8.2
G27.4	The 2nd spindle stop signal	SSTP2	2.8.2
G27.5	The 3rd spindle stop signal	SSTP3	2.8.2
G27.7	Spindle contour control switchsignal	CON	2.8.3
G28.1, G28.2	Gear selection signal	GR1, GR2	2.8.1
G28.7	The 2nd position encoder selection signal	PC2SLC	2.8.2
G29.0	The 2nd spindle gear selection	GR21	2.8.2

	signal		
G29.1	The 2nd spindle gear selection	GR22	2.8.2
G29.2	The 3rd spindle gear selection	GR31	2.8.2
G29.3	The 3rd gear selection	GR32	2.8.2
G29.4	Spindle speed arrival signal	SAR	2.8.1
G29.6	Spindle stop signal	SSTP	2.8.1
G30	Spindle override signal	SOV0 ~ SOV7	2.8.1
G32.0 ~ G32.7 G33.0 ~ G33.3	Spindle motor speed command input signal	R01I ~ R12I	2.8.1
G33.7	Spindle motor speed selection command signal	SIND	2.8.1
G34.0 ~ G34.7 G35.0 ~ G35.3	The 2nd spindle motor speed command input signal	R01I2 ~ R12I2	2.8.2
G35.7	The 2nd spindle motor speed selection command signal	SIND	2.8.2
G39.0～G39.5	Tool compensation number selection signal	OFN	2.10.4
G39.7	Signal selection of tool compensation value write-in method	GOQSM	2.10.4
G40.6	Position record signal	PRC	2.10.5
G43.0 ～ G43.2, G43.5, G43.7	Mode selection signal	MD1, MD2, MD4, DNC1, ZRN	2.2.4.1
G44.0	Optional block skip signal	BDT1	2.5.6.1
G44.1	All-axis machine lock signal	MIK	2.5.3.1
G46.1	Single block signal	SBK	2.5.5.1
G46.7	Dry run signal	DRN	2.5.4.1
G61.0	Rigid tapping signal	RGTAP	2.8.3
G61.4	The 1st spindle selection signal of rigid tapping	RGTSP1	2.8.2
G61.5	The 2nd spindle selection signal of rigid tapping	RGTSP2	2.8.2
G61.6	The 3rd spindle selection signal of rigid tapping	RGTSP3	2.8.2
G70.4	The 1st spindle reverse signal	SRVA	2.8.2
G70.5	The 1st spindle positive signal	SFRA	2.8.2
G74.4	The 2nd spindle reverse signal	SRVB	2.8.2
G74.5	The 2nd spindle positive signal	SFRB	2.8.2
G78.4	The 3rd spindle reverse signal	SRVC	2.8.2
G78.5	The 3rd spindle positive signal	SFRC	2.8.2
G100.0 ~ G100.4	Feed axis and direction selection	+J1 ~ +J5	2.3.1.1

G102.0 ~ G102.4	signal	-J1 ~ -J5	2.3.1.1
G114.0 ~ G114.4	Overtravel signal	+L1 ~ +L5	2.2.6.1
G116.0 ~ G116.4		-L1 ~ -L5	2.2.6.1
G136.0 ~ G136.4	PLC control axis selection signal	EAX1 ~ EAX5	2.13.3.1
G137.0, G137.1	PLC axis rapid traverse override signal	ROV1E, ROV2E	2.13.3.27
G137.5	PLC axis override cancel signal	OVCE	2.13.3.26
G137.6	PLC axis manual rapid traverse selection signal	RTE	2.13.3.29
G137.7	PLC axis dry run signal	DRNE	2.13.3.28
G138	PLC axis feedrate override signal	FV0E ~ FV7E	2.13.3.25
G140.0	PLC axis miscellaneous function completion signal	EFINA	2.13.3.15
G140.2	PLC axis buffering inhibited signal	EMBUFA	2.13.3.16
G140.3	PLC group 1 block end signal	ESBKA	2.13.3.9
G140.5	PLC group 1 axis control pause signal	ESTPA	2.13.3.8
G140.6	PLC group 1 reset signal	ECLRA	2.13.3.7
G140.7	PLC group 1 control command read signal	EBUFA	2.13.3.5
G141.0 ~ G141.6	PLC group 1 axis control signal	EC0A ~ EC6A	2.13.3.2
G141.7	PLC group 1 block stop disabled signal	EMSBKA	2.13.3.10
G142, G143	Axis control feedrate signal (PLC axis control group 1)	EIF0A ~ EIF15A	2.13.3.3
G144 ~ G147	Axis control data signal (PLC axis control group 1)	EID0A ~ EID31A	2.13.3.4
G150.0	PLC axis miscellaneous function completion signal	EFINB	2.13.3.15
G150.2	PLC axis buffering inhibited signal	EMBUFB	2.13.3.16
G150.3	PLC group 2 block end signal	ESBKB	2.13.3.9
G150.5	PLC group 2 axis control pause signal	ESTPB	2.13.3.8
G150.6	PLC group 2 reset signal	ECLRB	2.13.3.7
G150.7	PLC group 2 control command read signal	EBUFB	2.13.3.5
G151.0 ~ G151.6	PLC group 2 axis control signal	EC0B ~ EC6B	2.13.3.2
G151.7	PLC group 2 block stop disabled signal	EMSBKB	2.13.3.10
G152, G153	Axis control feedrate signal (PLC axis control group 2)	EIF0B ~ EIF15B	2.13.3.3

G154 ~ G157	Axis control data signal (PLC axis control group 2)	EID0B ~ EID31B	2.13.3.4
G160.0	PLC axis miscellaneous function completion signal	EFINC	2.13.3.15
G160.2	PLC buffering inhibited signal	EMBUFC	2.13.3.16
G160.3	PLC group 3 block end signal	ESBKC	2.13.3.9
G160.5	PLC group 3 axis control pause signal	ESTPC	2.13.3.8
G160.6	PLC group 3 reset signal	ECLRC	2.13.3.7
G160.7	PLC group 3 control command read signal	EBUFC	2.13.3.5
G161.0 ~ G161.6	PLC group 3 axis control signal	EC0C ~ EC6C	2.13.3.2
G161.7	PLC group 3 block stop disabled signal	EMSBKC	2.13.3.10
G162, G163	Axis control feedrate signal (PLC axis control group 3)	EIF0C ~ EIF15C	2.13.3.3
G164 ~ G167	Axis control data signal (PLC axis control group 3)	EID0C ~ EID31C	2.13.3.4
G170.0	PLC axis miscellaneous function completion signal	EFIND	2.13.3.15
G170.2	PLC buffering inhibited signal	EMBUFD	2.13.3.16
G170.3	PLC group 4 block end signal	ESBKD	2.13.3.9
G170.5	PLC group 4 axis control pause signal	ESTPD	2.13.3.8
G170.6	PLC group 4 reset signal	ECLRD	2.13.3.7
G170.7	PLC group 4 control command read signal	EBUFD	2.13.3.5
G171.0 ~ G171.6	PLC group 4 axis control signal	EC0D ~ EC6D	2.13.3.2
G171.7	PLC group 4 block stop disabled signal	EMSBKD	2.13.3.10
G172, G173	Axis control feedrate signal (PLC axis control group 4)	EIF0D ~ EIF15D	2.13.3.3
G174 ~ G177	Axis control data signal (PLC axis control group 4)	EID0D ~ EID31D	2.13.3.4
G201	Current tool position signal	NT00 ~ NT07	2.9
G254.0	The 1st Spindle contour control switching signal	CONS1	2.8.3
G254.1	The 2nd Spindle contour control switching signal	CONS2	2.8.3
G254.2	The 3rd Spindle contour control switching signal	CONS3	2.8.3

APPENDIX 2 F Signals List

Address	Signal	Symbol	Section
F0.0	The signal in the treatment of the rewinding	RWD	2.5.2.3
F0.4	Feed dwell signal	SPL	2.5.1.4
F0.5	Cycle start signal	STL	2.5.1.3
F0.6	Servo ready signal	SA	2.1.2
F0.7	Auto running signal	OP	2.5.1.5
F1.0	Alarm signal	AL	2.2.3
F1.1	Reset signal	RST	2.5.2.2
F1.3	Distribution completion signal	DEN	2.7.4.3
F1.4	Spindle enable signal	ENB	2.8.1
F1.7	CNC ready signal	MA	2.2.2
F2.0	Inch input signal	INCH	2.10
F2.1	Rapid traverse signal	RPDO	2.6.1
F2.2	Constant surface speed signal	CSS	2.8.1
F2.3	Thread cutting signal	THRD	2.11
F2.7	Dry run check signal	MDRN	2.5.4.2
F3.0	STEP mode check signal	MINC	2.2.4.2
F3.1	MPG mode check signal	MH	2.2.4.2
F3.2	MANUAL mode check signal	MJ	2.2.4.2
F3.3	MDI mode check signal	MMDI	2.2.4.2
F3.4	DNC mode check signal	MRMT	2.2.4.2
F3.5	AUTO mode check signal	MMEM	2.2.4.2
F3.6	EDIT mode check signal	MEDT	2.2.4.2
F4.0	Optional block skip check signal	MBDT1	2.5.6.2
F4.1	All-axes machine lock check signal	MMLK	2.5.3.2
F4.2	Manual absolute check signal	MABSM	2.5.7.2
F4.3	Single block check signal	MSBK	2.5.5.2
F4.4	Miscellaneous function lock check signal	MAFL	2.7.5.2
F4.5	Machine zero return mode check signal	MREF	2.2.4.2
F6.1	The resetting confirmation signal based upon the MDI	MDIRST	2.5.2.6
F7.0	Miscellaneous function strobe signal	MF	2.7.1.1
F7.2	Spindle speed function strobe signal	SF	2.7.2
F7.3	Tool function strobe signal	TF	2.7.3
F8.4	2M miscellaneous function strobe signal	MF2	2.7.1.3
F8.5	3M miscellaneous function strobe signal	MF3	2.7.1.3

Address	Signal	Symbol	Section
F9.4	Decode M signal	DM30	2.7.1.2
F9.5		DM02	2.7.1.2
F9.6		DM01	2.7.1.2
F9.7		DM00	2.7.1.2
F10 ~ F13	Miscellaneous function code signal	M00 ~ M99	2.7.1.1
F14 ~ F15	2M miscellaneous function code signal	M200 ~ M299	2.7.1.3
F16 ~ F17	3M miscellaneous function code signal	M300 ~ M399	2.7.1.3
F22 ~ F25	Spindle speed code signal	S00 ~ S31	2.7.2
F26 ~ F29	Tool function code signal	T00 ~ T31	2.7.3
F36.0 ~ F37.3	The 1st spindle S12-digit signal	R01O ~ R12O	2.8.1
F38.2	The 2nd spindle enable signal	ENB2	2.8.2
F40 ~ F41	The 1st spindle actual speed signal	AR00 ~ AR15	2.8.1
F44.1	Spindle contour control switching completion signal	FSCSL	2.8.3
F62.7	Target parts count reached signal	PRTSF	2.12
F94.0 ~ F94.4	Machine zero return end signal	ZP1 ~ ZP5	2.4.1.1
F96.0 ~ F96.4	The 2nd reference point return end signal	ZP21 ~ ZP25	2.4.1.1
F98.0 ~ F98.4	The 3rd reference point return end signal	ZP31 ~ ZP35	2.4.1.1
F100.0 ~ F100.4	The 4th reference point return end signal	ZP41 ~ ZP45	2.4.1.1
F102.0 ~ F102.4	Axis moving signal	MV1 ~ MV5	2.1.1.1
F106.0 ~ F106.4	Axis moving direction signal	MVD1 ~ MVD5	2.1.1.2
F112.0 ~ F112.4	PLC distribution completion signal	EADEN1 ~ EADEN5	2.13.3.31
F120.0 ~ F120.4	Reference point setting signal	ZRF1 ~ ZRF5	2.4.1.2
F129.5	PLC axis override 0% signal	EOV0	2.13.3.30
F129.7	PLC controlled axis selection status signal	EAXSL	2.13.3.17
F140.0	PLC axis in-position signal	EINPA	2.13.3.18
F140.1	PLC axis following error zero checking signal	ECKZA	2.13.3.19
F140.2	PLC axis alarm signal	EIALA	2.13.3.20
F140.3	PLC miscellaneous function execution signal	EDENA	2.13.3.22
F140.4	PLC axis move signal	EGENA	2.13.3.21
F140.5	PLC axis “+” direction overtravel signal	EOTPA	2.13.3.24

F140.6	PLC axis “–” direction overtravel signal	EOTNA	2.13.3.23
F140.7	Axis control command read completed signal (PLC axis control group 1)	EBSYA	2.13.3.6
F141.0	PLC miscellaneous function strobe signal	EMFA	2.13.3.12
F141.1	PLC buffer full signal	EABUFA	2.13.3.32
F141.2	PLC miscellaneous function 2 strobe signal	EMF2A	2.13.3.13
F141.3	PLC miscellaneous function 3 strobe signal	EMF3A	2.13.3.14
F142, F143	PLC miscellaneous function code signal	EM11A ~ EM48A	2.13.3.11
F150.0	PLC axis in-position signal	EINPB	2.13.3.18
F150.1	PLC axis following error zero checking signal	ECKZB	2.13.3.19
F150.2	PLC axis alarm signal	EIALB	2.13.3.20
F150.3	PLC miscellaneous function execution signal	EDENB	2.13.3.22
F150.4	PLC axis move signal	EGENB	2.13.3.21
F150.5	PLC axis “+” direction overtravel signal	EOTPB	2.13.3.24
F150.6	PLC axis “-” axis direction overtravel signal	EOTNB	2.13.3.23
F150.7	Axis control command read completed signal (PLC axis control group 2)	EBSYB	2.13.3.6
F151.0	PLC miscellaneous function strobe signal	EMFB	2.13.3.12
F151.1	PLC buffer full signal	EABUFB	2.13.3.32
F151.2	PLC miscellaneous function 2 strobe signal	EMF2B	2.13.3.13
F151.3	PLC miscellaneous function 3 strobe signal	EMF3B	2.13.3.14
F152, F153	PLC miscellaneous function code signal	EM11B ~ EM48B	2.13.3.11
F160.0	PLC axis in-position signal	EINPC	2.13.3.18
F160.1	PLC axis following error zero checking signal	ECKZC	2.13.3.19
F160.2	PL axis alarm signal	EIALC	2.13.3.20
F160.3	PLC miscellaneous function execution signal	EDENC	2.13.3.22
F160.4	PLC axis move signal	EGENC	2.13.3.21

F160.5	PLC axis “+” direction overtravel signal	EOTPC	2.13.3.24
F160.6	PLC axis “–” direction overtravel	EOTNC	2.13.3.23
	signal		
F160.7	Axis control command read completed signal (PLC axis control group 3)	EBSYC	2.13.3.6
F161.0	PLC miscellaneous function strobe signal	EMFC	2.13.3.12
F161.1	PLC buffer full signal	EABUFC	2.13.3.32
F161.2	PLC miscellaneous function 2 strobe signal	EMF2C	2.13.3.13
F161.3	PLC miscellaneous function 3 strobe signal	EMF3C	2.13.3.14
F162, F163	PLC miscellaneous function code signal	EM11C ~ EM48C	2.13.3.11
F170.0	PLC axis in-position signal	EINPD	2.13.3.18
F170.1	PLC axis following error zero checking signal	ECKZD	2.13.3.19
F170.2	PLC axis alarm signal	EIALD	2.13.3.20
F170.3	PLC miscellaneous function execution signal	EDEND	2.13.3.22
F170.4	PLC axis move signal	EGEND	2.13.3.21
F170.5	PLC axis “+” direction overtravel signal	EOTPD	2.13.3.24
F170.6	PLC axis “–” direction overtravel signal	EOTND	2.13.3.23
F170.7	Axis control command read completed signal (PLC axis control group 4)	EBSYD	2.13.3.6
F171.0	PLC miscellaneous function strobe signal	EMFD	2.13.3.12
F171.1	PLC buffer full signal	EABUFD	2.13.3.32
F171.2	PLC miscellaneous function 2 strobe signal	EMF2D	2.13.3.13
F171.3	PLC miscellaneous function 3 strobe signal	EMF3D	2.13.3.14
F172, F173	PLC miscellaneous function code signal	EM11D ~ EM48D	2.13.3.11
F192.0 ~ F192.4	PLC control signal	EACNT1 ~ EACNT5	2.13.3.33
F200.0 ~ F201.3	The 2nd spindle S12-digit signal	R01O2 ~ R12O2	2.8.2
F202 ~ F203	The 2nd spindle actual speed signal	AR002 ~ AR152	2.8.2